NOVEMBER, 1941.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

2198. Momentum distribution in molecular systems. IV. The hydrogen molecular ion H_2^+. W. E. Duncanson. **V. Momentum distribution and the shape of the Compton line for CH_6, C_2H_6, C_2H_4 and C_2H_2.** W. E. Duncanson and C. A. Coulson. *Proc. Camb. Phil. Soc.*, **37,** *pp.* 397–421, *Oct.*, 1941.—The momentum distribution for the electron in the hydrogen molecular ion has been calculated for various wave functions, including the one used by James with which he obtained a good value for the binding energy. The method is outlined and the results show appreciable change with improvement in the wave function. Implications of the present calculations on similar work on the H_2 molecule are discussed.—It is assumed that each electron acts as a single scattering centre so that the mean radial distribution for the molecule is just the sum of the various partial distributions for each electron separately. The electrons are supposed to be paired together in the formation of localized bonds, and the contributions from each type of bond have to be separately determined. When superposed, these give the momentum distribution for the whole molecule. Such distributions are similar in shape, but the peak value of the momentum curves moves to higher values of p as the C–C bond becomes more saturated. A comparison of the various partial distributions for C_2H_4 shows that the C–H bond is an important factor in the momentum distribution of such molecules. In other hydrocarbon molecules we may presume that the proportion of C–H bonds will be very significant in determining the breadth of the momentum distribution curve, and hence of the width of the Compton line; in fact the ½-width of the Compton line decreases both with an increase in the number of the C–H bonds, and with increased saturation of the C–C bonds. In the only case where experimental results are available, CH_4, the discrepancy between theory and experiment amounts to about 30%. Reasons for this discrepancy are discussed; in part the discrepancy may be attributed to the approximations used in the wave functions; but reasons are given for supposing that in part also it arises from an incorrect interpretation of the experimental results. [See Abstr. 295 (1940)]. Authors.

2199. New bands in the triplet carbon system. R. K. Asundi. *Proc. Indian Acad. Sci. A*, **12,** *pp.* 491–493, *Nov.*, 1940.—A few new band heads belonging to the triplet carbon band system of CO are reported. These necessitate an increase of 2 units in the existing v' numbering. The origin of the system may be still further in the region of longer waves but is definitely shifted at least to $\nu = 13\,310{\cdot}7$ cm.$^{-1}$ according to these new results, thus locating the $d^3\Pi_1$ level at 61 785·5 cm.$^{-1}$ from the ground level of the CO molecule. Author.

2200. Structure of electronic bands of polyatomic molecules. I. Prolate approximation for XY_2 molecules. N. Metropolis. *Phys. Rev.*, **60,** *pp.* 283–294, *Aug.* 15, 1941.—The 4 characteristic cases of changes in dimensions during the electronic transition are considered and yield 4 typically different band structures. The variation in band structure with bond distance and apex angle is worked out in detail for SO_2 molecules and theoretical quantitative diagrams of band structures are given for a temperature of 200°K. The intensity distributions shown in these diagrams are valid (for some adjusted temperature) for any polyatomic molecules in which the moments of inertia of the ground state have the same ratio as those in SO_2. If, in addition, the same is true of the moments of inertia in the upper states, the entire band structure is identical at some adjusted scale. The correlation between rotational structure and vibrational intensity distribution is worked out, from which conclusions about the changes in dimensions of the XY_2 molecule in the transition can be made. It is shown how a qualitative examination of the observed (resolved or unresolved) rotational structure may guide or confirm the associated vibrational analysis. Finally, a comparison with the available data on SO_2 and ClO_2 is made. Author.

2201. Investigations of nuclear reactions of N and S with neutrons. P. Huber. *Helv. Phys. Acta*, **14,** 3, *pp.* 163–188, 1941. *In German.*—The $^{14}N(n,p)\,^{14}C$ reaction is studied and from the data the mass of ^{14}C is estimated as 14·007 75 ± 0·000 20. Bombardment of S with 2·76 eMV neutrons gives 2 reactions, (*a*) $^{32}S(n,\alpha)^{29}Si$, and (*b*) $^{32}S(n,p)^{32}P$. For (*a*) the energy of transformation is 1·2 ± 0·1 eMV and for (*b*) it is − 0·93 ± 0·1 eMV. The masses of ^{29}Si and ^{32}P are estimated as 28·986 09 ± 0·000 54 and 31·984 14 ± 0·000 49, respectively. W. R. A.

2202. Interaction between nuclear particles. L. Eisenbud and E. P. Wigner. *Proc. Nat. Acad. Sci., Wash.*, **27,** *pp.* 281–289, *June*, 1941.—

Assuming that the forces between the nuclear particles satisfy certain symmetry and invariance conditions, not including Lorentz invariance, the most general type of interaction is derived. The physical properties of these forces are discussed. R. P.

2203. Theory of nuclear surface energy. E. Feenberg. *Phys. Rev.*, **60,** *pp.* 204–207, *Aug.* 1, 1941.—The eigenvalues of a free particle in a spherical potential well of finite depth are computed and used to calculate the surface energy of nuclear systems. No assumptions are made concerning the specifically nuclear forces. For depth and radius $56mc^2$ and $\frac{1}{2}A^{\frac{1}{3}}e^2/mc^2$, respectively, the computed surface energy is about $\frac{2}{3}$ the empirical value. A well of infinite depth yields a surface energy more than double the empirical value. One-dimensional and cubical wells are discussed for the purpose of orientation. AUTHOR.

2204. Formation of supermolecules. K. L. Wolf, H. Dunken and K. Merkel. *Z. phys. Chem. B*, **46,** *pp.* 287–312, *Aug.*, 1940. *In German.*—The law of mass action is applied to stoichiometric association. For a number of dissolved substances the equilibrium constants are given; 3 typical cases of equilibrium may be distinguished, depending on the kind of association. The volume change and heat of mixing as dependent on concentration may be calculated from the law of mass action. For a complete molecular description of liquids volume and dielectric measurements are also required. [See Abstr. 3330 (1937), 2536 (1940)]. R. N.

2205. Disintegration of long-chain molecules. I. Sakurada and S. Okamura. *Z. phys. Chem. A*, **187,** *pp.* 289–296, *Nov.*, 1940. *In German.*—An equation based on statistical considerations is given for the relation between the average mol. wt. found from viscosity measurements and the number of breaks in long molecular chains. The kinetics of the hydrolytic decomposition of cellulose in concentrated acid solutions are investigated. The results of calculations and experiments are in good agreement. R. N.

See also Abstracts 2207, 2211, 2300, 2330, 2331.

COLLOIDS.

2206. Microscopic structure of the wool fibre. C. W. Hock, R. C. Ramsay and M. Harris. *Bur. Stand. J. Res.*, *Wash.*, **27,** *pp.* 181–190, *Aug.*, 1941.—Treatment of chemically modified wool with the enzyme, pepsin, was found to be an excellent method for releasing individual cells for study. Microdissection shows that the striated appearance of the cortical cells is due to the presence of many fibrils which can be separated with micro-needles. Near the centre of each cell is a nucleus which has a granular structure. Between crossed nicols the fibrillar part of the cortical cells appears birefringent, whereas the nucleus does not. The scales show little internal organization such as exhibited by the cortical cells. When examined with crossed nicols they appear non-birefringent. Unlike the cells of the cortex, the scales are not easily separated by treatment with enzymes, but remain attached to each other in a manner comparable to the arrangement of shingles on a roof. A comparison of root and shaft of the fibre reveals numerous differences in reaction to microchemical colour tests, as well as differences in cellular structure. The shaft appears birefringent, whereas the root does not. These and other observations clearly indicate that, as the cells of the root emerge into the shaft, a number of physical and chemical changes take place simultaneously. When wool is placed in chlorine water, swellings arise on the surface of the fibres (Allwörden reaction). Evidence is presented in support of the view that these sacs arise solely from the scales and that their formation is associated with the reaction of the chlorine with disulphide groups of the cystine in the scales. AUTHORS.

2207. Thread formation, thread properties and molecular structure (molecular-physical considerations on the spinning process). F. H. Müller. *Phys. Z.*, **42,** *pp.* 123–129, *June* 15, 1941. *In German.*—The production of the thread in the nozzle and its fixation are very fully discussed in the light of present-day knowledge of the mechanism of deformation. A few final remarks are included on the comparison of synthetic with natural fibres. H. G. S.

See also Abstract 2320.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2208. Effect of stress on internal friction in polycrystalline Cu. A. W. Lawson. *Phys. Rev.*, **60,** *pp.* 330–335, *Aug.* 15, 1941.—The internal friction of polycrystalline specimens of oxygen-free Cu, subjected to compressive stress, increases and then decreases with continuously increasing stress. A complementary behaviour of Young's modulus is found. Although the Taylor dislocation of plasticity is capable of explaining qualitatively the data obtained at any one temperature, no simple explanation of the temperature-independence of the effect is available. AUTHOR.

2209. The X-ray diffraction pattern of tricalcium aluminate. L. J. Brady and W. P. Davey. *J. Chem. Phys.*, **9,** *pp.* 663–666, *Sept.*, 1941.—Using a new type of X-ray diffraction apparatus, the diffraction pattern of high-purity tricalcium aluminate is recorded automatically in the form of

a graph of intensity *v.* angle. The unit cube containing 264 atoms has an edge of 15·235Å.
AUTHORS.

2210. Crystal structure of *dl*-alanine. H. A. LEVY AND R. B. COREY. *J. Amer. Chem. Soc.*, **63,** *pp.* 2095–2108, *Aug.*, 1941.—Weissenberg X-ray data using Cu $K\alpha$ radiation show that crystals of *dl*-alanine are built upon an orthorhombic unit. The structure consists of alanine molecules linked together by a 3-dimensional framework of H bonds, which is responsible for an abnormally close approach (3·64 Å) of methyl radicals of adjacent molecules. Special features of the structure are discussed and their implications in the solution of certain problems of protein structure are briefly mentioned. AUTHORS.

2211. Transformation of hydrated cellulose into natural cellulose. VII. T. KUBO. *Z. phys. Chem. A*, **187,** *pp.* 297–312, *Nov.*, 1940. *In German.*—The crystal structures of highly orientated ramie and of the transformation product of hydrated cellulose into natural cellulose are investigated and discussed. The change in intensity of the diatropic interference marks is explained by a parallel shift of the main valency chain of the molecules and a free rotation of the O atom 5 around the bond axis of the C atoms 5 and 6. R. N.

2212. α/β brass type of equilibrium. K. W. ANDREWS AND W. HUME-ROTHERY. *Proc. Roy. Soc. A*, **178,** *pp.* 464–473, *Aug.* 15, 1941.—The α/β brass type of equilibrium is influenced by atomic size factors and lattice distortions in the different systems. Following the development of high-temperature X-ray technique, a complete set of lattice spacings is reported for the α, β, and β' phases in the 2-phase alloys of the system Cu-Zn in the range 300° to 870°, and similar spacings for the α and β phases in Cu-In, Cu-Sn, Cu-Ga, and Cu-Al systems at 672°. Data include electron concentrations of α and β phases at $\alpha/\alpha+\beta$ and $\alpha+\beta/\beta$ boundaries, and mean volume per atom and per electron for α and β phases. Measurements are also given for the lattice spacings of Cu up to 871°, since these are required to estimate the lattice distortion of the primary solid solution at the different temperatures. Graphs are given and discussed for the electron concentration of the phases plotted against volumes per atom of α and β phases in equilibrium in the different systems at 672°, and also against the mean volumes per electron (i.e. mean vol. per atom/number of valency electrons per atom).
N. M. B.

2213. Supercooled silicates and their importance in considerations of the liquid state. E. PRESTON. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 568–584, *Sept.*, 1941.—A survey is given of studies of the properties of crystallization, viscosity, and surface tension (in relation to evidence of association) and electrical conductivity, showing that silicate glasses are super-cooled liquids and may be regarded as solutions, the constituents of which are associated to a degree depending on composition and temperature. Recent X-ray researches on the structure of glasses indicate that it is typical of the liquid state. Glass at room temperatures possesses a static structure as opposed to the dynamic configuration of the particles of a normal liquid, and hence simple glasses may be of great value in the further elucidation and the provision of an adequate theory of the structure of liquids.
N. M. B.

2214. On the simplest crystalline liquid substances. A contribution to the chemical morphology of liquids. C. WEYGAND AND R. GABLER. *Z. phys. Chem. B*, **46,** *pp.* 270–275, *Aug.*, 1940. *In German.*—The *p-n*-alkyl benzoic acids are found to be the simplest type of crystalline liquids. The probable structure of their double molecules is discussed. The crystalline solid and crystalline liquid transition points of *p-n*-alkoxy benzoic acids as given by Bennett and Jones (*J. Chem. Soc.*, *p.* 420, 1939) are corrected. R. N.

See also Abstracts 2325, 2358, 2369, 2416, 2417.

DENSITY.

2215. Relation between viscosity and density of liquids and liquid mixtures. M. K. SRINIVASAN. *Phil. Mag.*, **32,** *pp.* 253–258, *Sept.*, 1941.—An equation of the type $\log\eta=\alpha+\beta/(\rho_0-\rho)$, where η is viscosity, ρ density, and α, β and ρ_0 are constants, is proposed and is shown to represent the viscosity variation with temperature of unassociated and associated organic and inorganic liquids, and of binary liquid mixtures at constant composition. The only case where it fails, among the liquids studied, is that of water. Data are tabulated in detail for octane, 3-methyl heptanol 3, and Ga, and are summarized for 22 other liquids or substances in the liquid state. The equation also represents at constant temperature the viscosity variation of ideal binary liquid mixtures with composition as illustrated by data for 8 organic systems. Results are compared with those of the equations of Andrade and of Macleod. N. M. B.

2216. Comparison between the observed density of crystalline rubber and the density calculated from X-ray data. W. H. SMITH AND N. P. HANNA. *Bur. Stand. J. Res., Wash.*, **27,** *pp.* 229–236, *Sept.*, 1941.

See also Abstract 2313.

DIFFUSION AND OSMOSIS.

2217. Diffusion calculations. H. A. LIEBHAFSKY. *J. Appl. Phys.*, **12,** *pp.* 707–710, *Sept.*, 1941.—An examination of the interrelation between the sine-series solution (for a slab with sealed periphery) and the error-function solution (for a semi-infinite body) of the fundamental Fourier equation. AUTHOR.

2218. The production of concentrated carbon (13) by thermal diffusion. A. O. NIER AND J. BARDEEN. *J. Chem. Phys.*, **9**, *pp.* 690–692, *Sept.*, 1941.—A thermal diffusion column 74 ft. long and employing methane is being used for the concentration of C^{13}. Every 48 hr. 308 mg. of methane are removed in which the C^{13}/C^{12} ratio has been increased 11·5 times. The power consumption is 6490 W and 6 l./min. of cooling water is used. An expenditure of 156 kWh of energy thus results in a transport of 13·5 mg. of C^{13} per 24 hrs. The measured output is in good agreement with the value computed from the theory. AUTHORS.

2219. Determination of molecular and ionic weights of dissolved substances by dialysis and free diffusion. H. BRINTZINGER. *Z. phys. Chem. A*, **187**, *pp.* 317–334, *Dec.*, 1940. *In German.*—A polemic paper refuting objections raised by Jander and Spandau against the dialysis method [see Abstr. 699 (1941)]. R. N.

2220. Bituminous coatings. A. O. BECKMAN, R. M. BADGER, E. E. GULLEKSON AND D. P. STEVENSON. *Industr. Engng Chem.*, **33**, *pp.* 984–990, *Aug.*, 1941.—Possible mechanisms causing corrosion of metals underneath bituminous membranes have been studied. Electro-osmosis, diffusion of water, diffusion of electrolytes and intrusion of water through small holes or fissures in the membrane, were studied experimentally. It was found that electro-osmosis and ionic diffusion are very small, and that diffusion of water is not sufficiently large to account for the amount of rusting frequently encountered in commercial experience. From surface-tension and wetting-angle measurements of the (bituminous membrane)/(aqueous solution) interface it is shown that a pin-hole imperfection of 0·1 mm. radius will permit penetration of water to a depth of several cm. in some bituminous membranes. AUTHORS.

2221. Permeability and absorption properties of bituminous coatings. A. P. ANDERSON AND K. A. WRIGHT. *Industr. Engng Chem.*, **33**, *pp.* 991–995, *Aug.*, 1941.—The permeability properties of bituminous coatings for the usual corrosive agents have been studied. Water and oxygen slowly permeate the coatings by molecular diffusion, but their concentrations remain so low as not to cause corrosion. Electrolytes are effectively excluded by macroscopically intact coatings. Practical tests show that pipe lines may be adequately protected from the action of corrosive soils by bituminous coatings that have been formulated correctly for the desired physical properties and have been properly applied. AUTHORS.

2222. Experiments on semi-permeability. C. JUNG. *Arch. Sci. Phys. Nat.*, **23**, (*Suppl. No.* 1. *C. R. Soc. Phys., Hist. Nat., Genève*, **58**, 1, *pp.* 100–102), *March–April*, 1941. *In French.*—A cellophane membrane impregnated with copper ferrocyanide has been used for osmotic-pressure experiments; it has a surface of 60 cm.^{2} and a thickness of 0·003 cm. Six experiments are described with this membrane which is perfectly impermeable to glucose but very permeable to urea, so that the former sets up an osmotic pressure by flow of water. It was, however, surprising to find that the passage of water from the hydrostatic pressure and that due to the osmotic pressure were by no means comparable. To explain this phenomenon the author envisages some kind of leakage at the membrane, i.e. a part only of the pores are semi-permeable while the others permit the solution to flow. H. H. HO.

See also Abstract 2374.

ELASTICITY AND PLASTICITY.

2223. On similarities between stress and flow patterns. M. HETÉNYI. *J. Appl. Phys.*, **12**, *pp.* 592–595, *Aug.*, 1941.—Two-dimensional plane stress systems were found to have features analogous to non-viscous potential flow fields on the one hand and to viscous flow on the other hand. In each case the fluid is assumed to be continuous, homogeneous and incompressible. AUTHOR.

2224. Correlation between elastic moduli and viscosity of liquids and plastics. A. GEMANT. *J. Appl. Phys.*, **12**, *pp.* 680–685, *Sept.*, 1941.—By means of a simple theory an equation, establishing a connection between elastic moduli of liquids and plastics and their viscosity, is derived. The equation, which contains 2 constants only, can be used either for a given substance in a range of varying temperature and pressure, or for a series of chemically related materials. The usefulness of the equation is shown on simple hydrocarbons, petroleum fractions, plasticized polyvinyl chlorides, and glasses. AUTHOR.

2225. Compressions and polymorphic transitions of 17 elements to 100 000 kg./cm.^{2} P. W. BRIDGMAN. *Phys. Rev.*, **60**, *pp.* 351–354, *Aug.* 15, 1941.

2226. On the dislocation theory of plastic deformation. J. S. KOEHLER. *Phys. Rev.*, **60**, *pp.* 397–410, *Sept.* 1, 1941.—Calculations of the strain energy have been made in the following cases : a dislocation in a uniform shear stress, 2 dislocations in an infinite medium, and a dislocation near a surface. The force acting is the gradient of the strain energy. A force is found which tends to attract dislocations toward the surface of a specimen. It is shown that twice as much energy is required to produce a certain amount of slip inside a solid as is required to produce the same amount of slip at the surface. The energy required to produce a dislocation is several eV per atomic plane. The energy stored in a material during work-hardening is calculated by assuming the dislocations arranged in a regular 2-dimensional lattice in the material. The density of dislocations for severely work-hardened material agrees with the predictions of other investigators. Numerical values are in agreement with experiment. AUTHOR.

2227. **Plasticity of phenol-formaldehyde resins and moulding powders.** L. M. DEBING AND S. H. SILBERKRAUS. *Industr. Engng Chem.*, **33,** *pp.* 972–975, *Aug.*, 1941.—A brief description of principal methods for determining the plasticity of phenolic moulding powders is presented. Typical 1-stage and 2-stage resins are compounded with and without various standard fillers to illustrate the inadequacy of any one method to classify these materials properly as to plasticity. The factors to be considered in the plasticity determination are discussed on the basis of experimental data presented. The complexities of this problem are such that empirical test methods appear to be the only practical methods available. Standardization of one method would be desirable, but no one test method appears to be adequate. AUTHORS.

2228. **Mechanical behaviour of bitumen.** W. LETHERSICH. *Rep. Brit. Elect. Allied Industr. Res. Assoc., Ref. A/T* 83, [28 *pp.*], 1941. *Abstr. in Electrician,* **127,** *p.* 166, *Sept.* 19, 1941.—The mechanical behaviour of bitumen can be completely expressed in terms of an equivalent mechanical (or electrical) circuit comprising 4 fundamental constants, namely 2 viscosities and 2 elasticities. The 2 viscosities vary with frequency in a characteristic manner and decrease with stress, indicating plasticity. Two of the bitumens tested showed work-hardening, that is, an increase of viscosity with strain; the remainder tended to show the opposite which is more pronounced at higher temperatures. The fundamental rheological constants can be associated with the distribution and nature of the dispersion of the asphaltenes (elastic) in the petrolenes (plastic). Brittleness is determined by the failure of the elastic component, and the conditions under which a bitumen is brittle can be found from the equivalent circuit described. Alternatively, a test of tensile strength with varying rates of loading will readily permit discrimination between the regions of brittle and plastic failure. AUTHOR.

2229. **Three-dimensional photo-elasticity using scattered light.** R. WELLER. *J. Appl. Phys.*, **12,** *pp.* 610–616, *Aug.*, 1941.—It is possible to use the polarization caused by the scattering of light within a photo-elastic model in place of the usual analyser in a photo-elastic polariscope, and thus to use an analyser which lies within the interior of the model. This is accomplished in practice by projecting into the model a beam of polarized light which has been collimated and passed through a slit, thus confining the beam to a thin sheet of light. Such a sheet will illuminate any desired plane section of the model, and in this section will appear interference fringes from which the stresses in the section may be determined. By successive examination of plane sections the model may be completely investigated. In this method the spacing of the fringes is the significant feature, rather than their order. It is possible, in many cases, to determine the directions of the principal stresses at interior points as well as the max. shear at such points. Boundary stresses are evaluated both in direction and magnitude. Equipment for this method differs in constructional details from that employed in plane-stress studies in that a source of light of higher intensity must be provided and a slit is used to restrict the beam. AUTHOR.

2230. **Photo-elastic study in vibrations.** W. M. MURRAY. *J. Appl. Phys.*, **12,** *pp.* 617–622, *Aug.*, 1941.—The writer has investigated the stress condition set up in a cantilever beam under resonant vibration. The model was a bar of transparent bakelite with rectangular cross section. After using an electromagnet with 60 c./s. and synchronized shutter, the method was discarded in favour of one in which frequency, phase and amplitude, could be varied independently in each case. The vibrator consisted of 2 equal masses rotated round parallel shafts in opposite directions, and the exposures were made by means of an electric stroboscope. The photo-elastic stress values along the edges of the beam are computed and plotted; they compare well with the theoretical values which are slightly higher. The photo-elastic analysis substantiates the theory and establishes its validity under the test conditions. G. E. A.

2231. **Dynamic properties of rubber.** S. D. GEHMAN, D. E. WOODFORD AND R. B. STAMBAUGH. *Industr. Engng Chem.*, **33,** *pp.* 1032–1038, *Aug.*, 1941.—A method for measuring dynamic properties is described. The rubber is driven by a loudspeaker arrangement of coil and magnetic field at a frequency of 60 c./s. The system is tuned to resonance by varying the mass of the vibrating system. The mass at resonance determines the dynamic modulus; the amplitude at resonance determines the internal friction. Dynamic resilience and relative rates of heat generation can be calculated. The static modulus comparable with the dynamic value can be secured by passing a direct current through the coil. Dynamic measurements are reported for a series of volume loadings of superspectra black, channel black, thermatomic black, zinc oxide, clay and blanc fixe. Authors.

2232. Critical study of some factors affecting the breaking strength and elongation of cotton yarns. H. F. Schiefer and R. S. Cleveland. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 325–342, *Sept.*, 1941. —The results of single-strand tests to determine the breaking strength and elongation of cotton yarns varying in yarn number and spun with 4 twist multipliers are reported. Pendulum and inclined-plane types of testing machines and 2 rates of loading were used in the tests. The results give information regarding the corrections of these machines, variability of the yarns, and the number of tests required for a given precision and probability. The effect of rate of loading on the breaking strength and elongation is discussed. The tests on the inclined-plane machine yielded a significantly higher breaking strength and lower elongation than the tests on the pendulum machine. These unexpected differences are not attributable to a difference in the rates of loading between the two machines. They are explainable on the basis of the mechanics of the two types of machines. Authors.

See also Abstract 2208.

MATHEMATICAL METHODS & THEORY OF MEASUREMENTS.

2233. On the fractional parts of the powers of a number. II. T. Vijayaraghavan. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 349–357, *Oct.*, 1941.

2234. On the sum function connected with primitive roots. S. S. Pillai. *Proc. Indian Acad. Sci. A*, **13**, *pp.* 526–529, *June*, 1941.

2235. A method of successive approximations of evaluating the real and complex roots of cubic and higher-order equations. Shih-Nge Lin. *J. Math. Phys.*, **20**, *pp.* 231–242, *Aug.*, 1941.

2236. A comparison of methods for evaluating the complex roots of quartic equations. H. S. Sharp. *J. Math. Phys.*, **20**, *pp.* 243–258, *Aug.*, 1941.

2237. On a conjecture of Mordell concerning binary cubic forms. H. Davenport. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 325–330, *Oct.*, 1941.

2238. The distribution of a product from several sources to numerous localities. F. L. Hitchcock. *J. Math. Phys.*, **20**, *pp.* 224–230, *Aug.*, 1941.

2239. Asymptotic expansion of integral functions defined by Taylor series. II. E. M. Wright. *Philos. Trans. A*, **239**, *pp.* 217–232, *Sept.* 19, 1941. [See Abstr. 631 (1940)].

2240. On the expansion of an arbitrary function in a series of eigenfunctions of boundary value problems. S. Minakshisundaram. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 462–465, *Nov.*, 1940.

2241. Elliptic and spheroidal wave functions. L. J. Chu and J. A. Stratton. *J. Math. Phys.*, **20**, *pp.* 259–309, *Aug.*, 1941.

2242. Notes on special systems of orthogonal functions. IV. The orthogonal functions of Whittaker's cardinal series. G. H. Hardy. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 331–348, *Oct.*, 1941.

2243. Some relations between Bessel functions of third order and confluent hypergeometric functions. N. A. Shastri. *Proc. Indian Acad. Sci. A*, **13**, *pp.* 521–525, *June*, 1941.

2244. An infinite series involving the product of Bessel functions and generalized Laguerre polynomials. R. S. Varma. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 532–534, *Dec.*, 1940.

2245. On average values of arithmetic functions. E. Fogels. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 358–372, *Oct.*, 1941.

2246. Rational approach to the numerical solution of Laplace's equation. (The 4-point influence method.) M. M. Frocht and M. M. Leven. *J. Appl. Phys.*, **12**, *pp.* 596–604, *Aug.*, 1941.

2247. Automatic integration of linear second-order differential equations by means of punched-card machines. L. Feinstein and M. Schwarzschild. *Rev. Sci. Instrum.*, **12**, *pp.* 405–408, *Aug.*, 1941.—It is shown how punched-card machines can be used for solving ordinary linear differential equations of the second order.

2248. On a class of singular integral equations. E. Reissner. *J. Math. Phys.*, **20**, *pp.* 219–223, *Aug.*, 1941.

2249. Least-square procedure for solving integral equations by polynomial approximation. F. B. Hildebrand and P. D. Crout. *J. Math. Phys.*, **20**, *pp.* 310–335, *Aug.*, 1941.

2250. On the subadditivity of the transfinite diameter. M. Schiffer. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 373–383, *Oct.*, 1941.

2251. Nomograms for the solution of spherical triangles. J. B. Friauf. *J. Franklin Inst.*, **231**, *pp.* 151–174, *Aug.*, 1941.—Seven nomograms are given, 6 for the first time. The first gives a complete solution of a triangle when 2 sides and included angle or 3 sides are known. In conjunction with the others, which facilitate accuracy, it may be employed for (*a*) determination of the great-circle distance between any 2 points on the earth's surface, the initial and final courses, and intermediate points and courses on the great-circle track; (*b*) navigation by the method of Marcq St. Hilaire; (*c*) determination of the declination and

hour angle of an observed star for identification purposes. Both theory and example are given.
G. F. F.

See also Abstract 2217.

MECHANICS, CLASSICAL.

2252. Velocity measurement of transient mechanical motions. S. Keilien. *J. Appl. Phys.*, **12**, *pp.* 634–637, *Aug.*, 1941.—Measurements of velocity of rapid non-recurrent mechanical motions by means of an oscillograph are described. Two methods of measurement are given: One by modifying the optical system of the oscillograph and the other by employing a slotted disc mounted on mechanism under test. These methods offer practical means of time/distance relation measurements of small devices, such as spring-actuated levers, cam mechanisms, triggers, etc., whose performance would be affected due to the additional load required to operate auxiliary measuring instruments. Author.

***2253. Eddy-current induction applied to the determination of accelerations.** J. E. Forbes. *Rev. Sci. Instrum.*, **12**, *pp.* 398–401, *Aug.*, 1941.—Eddy-current induction effects have been utilized in the construction of a simple electrical device whose voltage output is proportional to either rotational or vibratory accelerations. The output of the device is shown to be directly proportional to harmonic linear accelerations of small amplitiude and frequencies up to at least 50 c./s.
Author.

2254. Statistical mechanics of imperfect gases. E. W. Montroll and J. E. Mayer. *J. Chem. Phys.*, **9**, *pp.* 626–637, *Aug.*, 1941.—The application of statistical mechanical equations to the calculation of thermodynamic properties of imperfect gases has been hindered by the occurrence of highly multiple integrals in these equations. By observing that some of these multiple integrals are related to the iterated kernels of an integral equation involving the potential energy function of a pair of molecules, a technique is developed which expresses these integrals in terms of the characteristic values of the integral equation. This technique is applied to the calculation of third virial coefficients and the molecular distribution function (which is essentially the probability of finding 2 specified molecules in 2 small volume elements a distance r from each other) at various temperatures for imperfect gases with Lennard-Jones potential energy functions. Authors.

MECHANICS, QUANTUM.

2255. Correction for nuclear motion in H_2^+. V. A. Johnson. *Phys. Rev.*, **60**, *pp.* 373–377, *Sept.* 1, 1941.—The ground-state wave function of H_2^+ is accurately determined over values of R, the internuclear distance, from 1·20 to 2·75 atomic units and a table of the wave-function coefficients is given, along with the corresponding energy values. Correction terms are calculated for a set of values of R. Including the proper correction term, the total negative energy of H_2^+ for the equilibrium internuclear distance is found to be $1{\cdot}204\,72 \pm 0{\cdot}000\,01 E_H = 132,132 \pm 10$ cm.$^{-1}$ This result is compared with the consequences of certain experimental data. Author.

2256. Notes on the 2-centre problem in wave mechanics. II. Some new solutions of the wave equation. P. E. Marrack. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 384–396, *Oct.*, 1941.—The paper deals with new solutions of the differential equations of the 2-centre problem which are expressed in terms of the confluent hypergeometric function. By means of this function a solution of the λ-equation is obtained which enables the separation constant A to be found for small values of the parameter p in a rapidly convergent series, which for the special case of $m = 0$ is still more rapidly convergent. The solution for the μ-equation in the general case is of the same character as regards rapidity of convergence as solutions previously obtained, but when $m = 0$ it again possesses a higher rate of convergence as compared with solutions given by other investigators. [See Abstr. 980 (1939)].
Author.

2257. Statistical mechanics of nearest-neighbour systems. E. W. Montroll. *J. Chem. Phys.*, **9**, *pp.* 706–721, *Sept.*, 1941.—The evaluation of a factor of the partition function is reduced to the calculation of the largest characteristic value of a linear homogeneous operator equation involving the potential energy between 2 adjacent layers of lattice points in the solid. By assuming that all possible configurations of a layer are equally probable, a lower bound for the partition function for a simple cubic lattice is found in terms of the partition function of a cube of 8 molecules. The operator equation for a real crystal becomes quite complex, but in some problems it is possible to obtain characteristic vectors and characteristic values (and thus the partition function) at high and low temperatures. For intermediate temperatures a theory of resonance between the low-temperature "almost ordered" characteristic vectors and the high-temperature "almost disordered" characteristic vectors is developed. In cases where the operator equation can be solved for microcrystals, a few layers thick, a perturbation method is discussed in which interactions between the individual microcrystals are treated as perturbations. Some remarks are made concerning phase transitions and finally the general theory is applied to a superficial treatment of 2-dimensional ferromagnetic plates. AUTHOR.

See also Abstracts 2325, 2372, 2402.

SURFACE PROPERTIES.

2258. Adsorption isotherm and law of mass action. G. M. SCHWAB. *Z. phys. Chem. A*, **187**, *p.* 313, *Nov.*, 1940, *and* H. DUNKEN, *ibid.*, *p.* 314. *In German.*—Some remarks concerning Dunken's paper [Abstr. 1745 (1941)]. R. N.

2259. Measurement of contact angles. A. FERGUSON. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 554–566 ; *Disc.*, 566–568, *Sept.*, 1941.—A summary is given of a number of the various methods that have been employed for the measurement of contact angles and the relative merits of these methods are discussed. A. W.

2260. On Stephan's theorem. Contribution to the morphology of liquids. K. L. WOLF AND K. KLAPPROTH. *Z. phys. Chem. B*, **46**, *pp.* 276–286, *Aug.*, 1940. *In German.*—According to Stephan's theorem the ratio of molar inner latent heat to total molar surface energy equals 2. The authors show that the ratio may reach much higher values and depends for binary liquid mixtures on the space required by the particles of molar size. Thus the packing of the molecules inside the liquid and at its surface determines the ratio. Further researches may lead to a decision on the possibility of mutual isomorphic exchange of molecules in liquids and to a deeper insight into surface activity, when more experimental material is accessible. R. N.

2261. Surface studies with the electron microscope. V. K. ZWORYKIN AND E. G. RAMBERG. *J. Appl. Phys.*, **12**, *pp.* 692–695, *Sept.*, 1941.

***2262. An instrument for studying the topographies of fine-textured surfaces.** F. W. ADAMS, L. DEVOL AND H. R. LETNER. *Rev. Sci. Instrum.*, **12**, *pp.* 409–411, *Aug.*, 1941.—A profilograph, using a tracing point and optical lever system, makes profiles of fine-textured surfaces, magnifying the elevations and depressions by as much as 6 000×. With this instrument it is possible to detect surface variations as small as 0·04 μ. It is also possible to make a series of profiles along parallel paths from which topographic or relief maps can be prepared. Uses include the study of machined, lapped, and etched surfaces of importance in industry. AUTHORS.

2263. The thickness of the rigid water film at a quartz/water interface from a measurement of Newton's rings. W. G. EVERSOLE AND P. H. LAHR. *J. Chem. Phys.*, **9**, *pp.* 686–689, *Sept.*, 1941.—The thickness of the water film between a quartz lens and disc was determined by measuring the radii of successive Newton's rings. The squares of these radii are a linear function of the order of the rings from the centre, the intercept of the extrapolated graph of which is a function only of the radius of curvature of the lens and the vertical separation of the lens and plate. By comparing intercepts obtained from data taken before and after evaporation of a water layer, a value of the order of 100 Å was obtained for the thickness of the water film of each interface. AUTHORS.

See also Abstracts 2203, 2276, 2409.

VISCOSITY AND FRICTION.

2264. Viscosity of Russian and Rumanian lubricating oils at high pressure. R. B. DOW, J. S. MCCARTNEY AND C. E. FINK. *J. Inst. Petrol.*, **13**, *pp.* 301–309, *July*, 1941.—Physical and chemical data (composition, structure, mol. wt., etc.) of 4 Russian and 3 Rumanian oils are tabulated. Viscosities were determined at 100°, 130°, and 210°F. at various pressures up to 46 000 lb./in.^{2} Data are tabulated and plotted, an expression to fit them is found, and a discussion of results in relation to composition and in comparison with those at atm. pressure is given. N. M. B.

See also Abstracts 2215, 2224, 2369.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2265. The 200 in. telescope.** H. SPENCER JONES. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 497–516, *Sept.*, 1941. *Abstr. in Observatory*, **64**, *pp.* 129–135, *Oct.*, 1941.—The author describes the design and construction of the largest telescope in the world, now nearing completion in California. The design, casting and annealing of the mirror, the design and mechanical construction of the telescope and mounting, the method of guiding, and the optical arrangements and accessories are all fully discussed. A. HU.

STARS.

2266. The derivation of the velocity ellipsoid from proper motions. A. BROWN. *Mon. Not. Roy. Astr. Soc.*, **101**, 5–6, *pp.* 284–294, 1941.—On the basis of a particular method of analysing the proper motions of stars in a small region of the sky, the eccentricity, orientation and scale, of the velocity ellipse for the region can be obtained. The paper discusses the problem of combining such determinations of the velocity ellipse in different parts of the sky into a determination of the velocity ellipsoid. It is found that little reliance can be placed on the value obtained for the scale of the velocity ellipse, which is determined in terms of the projected solar motion for the region (near the solar apex it will become completely indeterminate). It is preferable, therefore, to use only the eccentricity ϵ of the ellipse and the orientation angle ϕ_0 of the major axis. Further, in choosing the quantities to be given equal weight in the solution, it is to be noticed that ϕ_0 becomes indeterminate when $\epsilon = 0$. The most suitable quantities to use in deriving the velocity ellipsoid appear to be

$$\mu = \frac{\epsilon^2}{2-\epsilon^2}\cos 2\phi_0 \text{ and } \nu = \frac{\epsilon^2}{2-\epsilon^2}\sin 2\phi_0.$$

The corresponding equations of condition are given. The results of applying the analysis to regions in the Cape Astrographic Zone (− 40° to − 52°) are given and by means of a variant method, applicable to this particular case, the corresponding velocity ellipsoid is deduced. AUTHOR.

2267. The problem of energy production in red giants. M. A. GREENFIELD. *Phys. Rev.*, **60,** *pp.* 175–183, *Aug.* 1, 1941.—Evolutionary changes in stars producing their energy by thermo-nuclear reactions of light elements are studied by the method of homology transformations. Formulae have been developed for the luminosity and radius of the star as a function of time. Formulae were also developed for the gravitational contraction of the star in the transitional stages between various nuclear reactions. Comparison of these two classes of formulae permits demarcation of the L/R diagram into regions in which either gravitational contraction or various nuclear reactions play the most important rôle. These regions have been correlated with various known groups of pulsating stars, thus permitting a definite nuclear reaction to be ascribed to each group. The observed constancy of period is consistent with the derived rates of evolution in different parts of the L/R diagram. AUTHOR.

2268. Photographic survey of galactic clusters. III. N.G.C. 103, 129, 133, 136, 146, 225, Anonymous $0^h\ 26^m{\cdot}2$, + 62°36′. G. ALTER. *Mon. Not. Roy. Astr. Soc.*, **101,** 5–6, *pp.* 298–308, 1941.—The investigation deals with 7 further clusters situated, with 1 exception, in a rich Cassiopeia region, the exception being N.G.C. 225, where an absorbing cloud is indicated not only by a dark background but by an irregularity in the range of distance moduli. An uncertainty in the identification and co-ordinates of 2 clusters is explained and it is shown that N.G.C. 133 does not seem to be a cluster at all, while the data given for it by previous investigations correspond to a cluster not named up to date and designated here as Anonymous; its co-ordinates are given. Tables showing co-ordinates, photographic and photovisual magnitudes of all measurable stars within the above cluster regions have been prepared. Copies can be supplied on request. [See Abstr. 1190 (1941)]. AUTHOR.

2269. Remarks on the Pegasus cluster of nebulae. J. B. EDSON AND F. ZWICKY. *Proc. Nat. Acad. Sci., Wash.*, **27,** *pp.* 366–369, *Aug.*, 1941.

2270. XZ Aurigae: an N-type variable. G. ALTER AND D. L. EDWARDS. *Mon. Not. Roy. Astr. Soc.*, **101,** 5–6, *pp.* 295–297, 1941.—Observations of XZ Aurigae show that this star is not a β Lyrae type as previously suggested, but has a very large colour index of + 4 to + 5, and spectral type N. There is no evidence of a 5-day period, and the star is probably a typical irregular or long-period red variable. The photographic magnitude was about 14·5, in agreement with Wolf's observations [Abstr. 616 (1917)]. The photovisual magnitude varied from about 10 to 11 during 3 months but never reached the values (12 to 13·2) found by Parenago. A remarkable feature is the change of colour index by about 1 magnitude in 10 days. Photovisual and photographic magnitudes of 34 comparison stars have been measured. AUTHORS.

2271. Determination of limb darkening in eclipsing binaries from colour-index observations, Z. KOPAL. *Proc. Amer. Phil. Soc.*, **84,** 5, *pp.* 565–587, 1941.—A method is developed for determining limb-darkening coefficients from the light curves of eclipsing binaries observed in 2 or more wavelengths. The method is applicable to both total and partial eclipses. For the purpose of a least-squares solution the equations of condition are reduced to a standard linear form. Several alternative forms of the equations of condition are suggested, and their weights and the effects of errors in the photometric measurements or geometrical elements are discussed. It is pointed out that, in the case of total eclipses, moderately precise measurements of the colour indices can yield a relatively accurate value for the difference in the darkening coefficients for the 2 respective wavelengths. The binaries U Sagittae and U Cephei are taken as illustrative examples. Fair agreement is found between the observed darkening coefficients and those predicted under the assumption of a constant continuous absorption coefficient. A. Hu.

SUN.

2272. Sunspots and insect outbreaks: an epidemiological study. D. S. MACLAGAN. *Proc. Univ. Durham Phil. Soc.*, **10,** *pp.* 173–199, *Dec.*, 1940.

2273. Observational search for polarization in the Ca line λ 4 227 near the Sun's limb. R. O. REDMAN. *Mon. Not. Roy. Astr. Soc.*, **101,** 5–6, *pp.* 266–272, 1941.—Profiles of the neutral Ca line λ 4 227 have been measured near the limb of the Sun, at sin $\theta = 0{\cdot}985$, in light polarized respectively parallel, and perpendicular to the limb. For the most part the profiles are indistinguishable, but there is a small difference amounting to about 1·8% of the continuous spectrum at line intensity 60%. Examination of likely sources of error suggests that this may be real. The ratio of theoretical to observed effect is of the order of 10. AUTHOR.

2274. On the weakening of the polarization effect by collision damping. H. ZANSTRA. *Mon. Not. Roy. Astr. Soc.*, **101**, 5–6, *pp.* 273–280, 1941.—Though the Ca atom, in the wavelength λ 4 227, should theoretically polarize light in the same way as a classical oscillator, Redman found that the polarization of the light within this line near the Sun's limb is no more than about $\frac{1}{10}$ of that predicted by the author on this assumption. It is now shown that the large collision damping attributed to this line is the probable cause of this weakening of the polarization, because of the hitherto unnoticed circumstance that it converts much of the light absorbed in the line wing to light of a frequency close to that of the line centre. AUTHOR.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

2275. Mapping from aerial surveys. A. T. BRITTON. *J. Instn Engrs, Aust.*, **13,** *pp.* 121–126, *May*, 1941.—The paper gives a review of methods of aerial survey with special reference to unsettled areas. Maps on scales of 1 mile to 0·1 mile to the inch are most suitable for aerial survey, and maps of greater and lesser scale should be prepared by ground methods. Correction of the photographs for camera tilt under the most favourable conditions is responsible for half the plotting costs. W. A. R.

HYDROSPHERE, PHYSICS OF THE.

See Abstract 2294.

LAND, PHYSICS OF THE.

2276. Adsorption of moisture from the moist air by the soils. L. D. MAHAJAN. *Indian J. Phys.*, **14,** *pp.* 441–450, *Dec.*, 1940.—Adsorption of moisture by soil increases with the range in humidity and with increase of thickness of the soil layer up to a limit depending on the character of the soil. Rate of adsorption is proportional to the log of the time of exposure. Adsorption decreases with the size of particles or particle groups. W. A. R.

2277. The flotation of sand in nature. V. E. MCKELVEY. *Amer. J. Sci.*, **239,** *pp.* 594–607, *Aug.*, 1941.—A review of the literature on the flotation of sand on the surface of water is made. Additional observations made on Trout Lake, Wisconsin, including the mechanical analyses of 2 samples, are recorded. The phenomenon is shown to have geological importance, is more common than is realized, is responsible for transportation of coarse sand and pebbles where transportation by other agencies is difficult, and may introduce a new element of sorting into sediments transported by other agencies. AUTHOR.

METEOROLOGY.

2278. Infra-red absorption by CO_2, with special reference to atmospheric radiation. G. S. CALLENDAR. *Quart. J. Roy. Met. Soc.*, **67,** *pp.* 263–274; *Disc.*, 274–275, *July*, 1941.—The rôle of atmospheric radiation in meteorological processes is emphasized as being of prime importance; normally the greater part of such radiation comes from water vapour, but in regions of the atmosphere nearly devoid of water vapour the radiation is mainly from CO_2. The author collects and coordinates observational data on the infra-red absorption of CO_2 in the region 9μ–18μ and presents it in a form in which it can be used for the calculation of energy exchanges. The different observations are compared with the aid of a simple function giving the absorption by any quantity of CO_2 in the different wave bands. A. HU.

2279. The Backergunje cyclone of May 25, 1941. *Sci. and Culture*, **7,** *pp.* 25–31, *July*, 1941.

2280. Disturbance of flow of air by heat conduction from the ground. Z. SAKADI. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 214–226, *March*, 1941.—A mathematical analysis to find the effect of variations in the ground temperature on the flow of air relative to its surface. R. W. P.

2281. Increase of intensity of direct solar radiation with height in the Alpine districts and distribution of turbidity in the lower layers of air. F. STEINHAUSEN. *Met. Z.*, **56,** *pp.* 172–181, *May*, 1939. *In German.*—The average diurnal change of direct solar radiation for different heights and angles of incidence and for the middle of each month are tabulated. The diurnal and annual variations are discussed. Ordinary and specific turbidity factors are investigated and their annual variation exhibited as a function of height. The total daily irradiation is given for a plane perpendicular to the direction of the beams and for a horizontal plane. Finally the results of pyranometric investigations are given for different levels showing the ratio of diffuse to direct solar radiation. R. N.

2282. Advective and convective, stationary and antidromal pressure variations. P. Raethjen. *Met. Z.*, **56,** *pp.* 133–142, *April*, 1939. *In German.*—The connection of pressure variations at sea level with temperature changes in tropo- and stratosphere are investigated. Only by antidromal advection and only in an antidromal and unsymmetric temperature field is a cyclone lowered by advective temperature change. Similar relations are found for convective lowering. Weather types, compensation, circulation of the atmosphere, divergence theory, Palmén's funnel and the combination of advective and convective pressure variation effects, are explained. R. N.

2283. A general variation principle of atmospheric dynamics. H. Ertel. *Met. Z.*, **56,** *pp.* 169–171, *May*, 1939. *In German.*—Present variation methods of atmospheric dynamics are too specialized to be of use in dynamic meteorology as they presuppose the density to be dependent on pressure only. In this mathematical paper the equations of atmospheric movements are derived from Hamilton's principle and are thus applicable to any thermodynamic change of state. The nonlinear equations of hydrodynamics may be solved approximately by the direct methods of Ritz's variation theory. R. N.

2284. Studies on Alpine thunderstorm activity. R. Weixlederer. *Met. Z.*, **56,** *pp.* 215–226, *June*, 1939. *In German.*—During the summer months (1935) a great number of observations in numerous high-level stations of Northern Tyrol and Vorarlberg were made in order to gain a deeper insight into cinematics and thermodynamics of Alpine thunderstorms. Statistical researches concerning the frequency, the places of formation and extinction, the direction of drift and the diurnal distribution, were made and are discussed. For a number of special cases the formation and expansion of thunderstorms are described in order to show the influences effective in mountainous regions. R. N.

2285. Vertical sections through cold fronts. J. Kümmer. *Met. Z.*, **56,** *pp.* 249–263, *July*, 1939. *In German.*—The isobaric distribution of temperature and density in the neighbourhood of the cold fronts of west-drift cyclones extending to large heights is investigated by means of 17 vertical sections. For the representation of these elements the virtual wet-potential temperature is introduced, defined as the wet-potential temperature belonging to the respective virtual temperature, and taken with slight corrections from Stüve's chart of adiabatics. A sharp boundary surface on the front side of the cold air could not be established in greater heights. The statistical results of previous investigations are confirmed; the cooling in larger heights precedes that on the ground. For one of the dates investigated a comparison is made between isopleths based on measured, potential, potential equivalent, and virtual wet-potential temperatures [Abstr. 2286 (1941)]. R. N.

2286. Why virtual wet-potential temperature in vertical sections? P. Raethjen. *Met. Z.*, **56,** *pp.* 263–265, *July*, 1939. *In German.*—The author gives the theoretical considerations which led to the choice of the virtual wet-potential temperatures for the representation of isobaric distribution of temperature and density in cold fronts [Abstr. 2285 (1941)]. R. N.

2287. The question of the European monsoon. J. Száva-Kovats. *Met. Z.*, **56,** *pp.* 149–157, *April*, 1939. *In German.*—The monsoon climate is characterized by unidirectional change of rainfall, cloud formation and humidity, with max. values in summer and min. values in winter. Its influence reaches much farther inland than usually assumed, and a broad belt of transition between monsoon and continental climates may be traced across large parts of inner Asia and Northern Europe. R. N.

2288. Contribution to the study of singularities. A. Roschkott. *Met. Z.*, **56,** *pp.* 181–185, *May, and pp.* 226–230, *June*, 1939. *In German.*—Based on 160 years' observations of temperature and rainfall during June in Vienna the fluctuation of the dates of singularities is revealed by tables and graphs. It seems doubtful whether the singularities are due to pure chance or whether it is possible to establish an underlying physical law which would allow weather forecasts to be based on the periodicity of singularities. The deviation of average pentade temperatures from a 145 years' average shows that a subnormal pentade in one year is followed rather regularly by low temperature of the next pentade in the following year. R. N.

2289. On the heat-wave over Northern India in April-May, 1941. C. Ramaswami. *Curr. Sci.*, **10,** *pp.* 285–286, *June*, 1941.

2290. Tentative summer and winter isotherms in Europe and Siberia for the ice age. R. Spitaler. *Met. Z.*, **56,** *pp.* 209–215, *June*, 1939. *In German.*—Using figures obtained from the Challenger expeditions the radiation constant *c* [see Abstr. 563, 564 (1936)] is found for determining present-day summer and winter isotherms for Europe and Siberia. The results of a previous paper [Abstr. 2035 (1941)] allow of making the necessary corrections for obtaining the data for the ice ages. A peculiar influence of Siberia on the European climate is stated and discussed. R. N.

2291. A new systematical division of the Alpine ice age. R. Spitaler. *Met. Z.*, **56,** *pp.* 266–269, *July*, 1939. *In German.*—The cold and warm phases of the ice ages may be determined by forming the yearly average of summer and winter radiation and plotting perihelic and aphelic values on a map. The results agree in general with those stated tentatively in a previous paper. [See Abstr. 2035 (1941)]. R. N.

2292. Twilight brightness (observations and considerations). J. Deinhofer and F. Lauscher. *Met. Z.*, **56,** *pp.* 153–159, *April*, 1939. *In German.*—[See Abstr. 751 and 1483 (1931)]. With clear sky the end of daylight is reached when the sun stands 7° below the horizon. Numerous observations and numerical values are given for the shortening of twilight by clouds, houses, woods, etc., and for the influence of valleys, cavities, streets and the like. Calculated results are checked by photometric measurements. The question of the hour when artificial light becomes necessary is discussed. R. N.

2293. Experiences with 6-colour recording instruments for resistance thermometry. G. Gründl. *Met. Z.*, **56,** *pp.* 230–239, *June*, 1939. *In German.*—The special precautions and methods of calibration are discussed for reaching a degree of accuracy adequate for scientific measurements. The influence of the instrument temperature on the temperature indication is especially investigated. For very accurate micro-meteorological measurements of longer duration present instruments are not suitable although they are quite sufficient for technical purposes. R. N.

2294. Inter-relationships of meteorology and oceanography. J. N. Carruthers. *Quart. J. Roy. Met. Soc.*, **67,** *pp.* 207–244; *Disc.*, 244–246, *July*, 1941.—In emphasizing the close connection between oceanography and climatology, the author pays principal attention to the influence of the Gulf Stream on the weather of N.W. Europe. Periods of lessened transport in the Florida Stream are believed to cause hydrodynamically a thinning of the warm central eddy (the Sargasso Sea); and the seas off the coats of Europe thereupon rise in temperature by a spreading of the warm surface currents. The influence of local branches of the main stream is traced in temperature, arboricultural and fishery records in Norway. In an Appendix members of the research staff of the Lowestoft fisheries laboratory correlate certain meteorological, oceanographic, and biological data which are relevant to the fishery industry. A. Hu.

SEISMOLOGY.

2295. The Imperial Valley earthquakes of 1940. F. P. Ulrich. *Bull. Seism. Soc. Amer.*, **31,** *pp.* 13–31, *Jan.*, 1941.—The paper gives a description of the damage done in these shocks, and contains a table of shocks recorded in the area since 1843. W. A. R.

2296. Periodicity of deep-focus earthquakes. H. McMurry. *Bull. Seism. Soc. Amer.*, **31,** *pp.* 33–82, *Jan.*, 1941.—The data from 250 earthquakes are analysed. No correlation that was definitely significant was found with twice the lunar and solar hour angles. The only stress changes that appear to warrant study with reference to their effect on earthquakes are those due to earth tides. W. A. R.

2297. Fire-department operations during the Long Beach earthquake of 1933. A. C. Du Ree. *Bull. Seism. Soc. Amer.*, **31,** *pp.* 9–12, *Jan.*, 1941.

2298. Effect of earthquakes on fire-alarm systems. F. B. Philbrick. *Bull. Seism. Soc. Amer.*, **31,** *pp.* 1–8, *Jan.*, 1941.—Experience shows that fire-alarm systems can be maintained if (*a*) the central office is of earthquake resisting construction, (*b*) storage batteries are so mounted as to withstand shock, (*c*) outside lines are carried underground with circuits designed to operate in spite of certain breaks. W. A. R.

RADIOACTIVITY.

2299. Rare-earth and transuranic elements. M. G. Mayer. *Phys. Rev.*, **60,** *pp.* 184–187, *Aug.* 1, 1941.—The possible existence of a second rare-earth group of elements, beginning with U and extending to the transuranic elements, is discussed by a calculation of the atomic eigenfunctions of the $4f$ and $5f$ electrons. Energy and spatial extension of the $4f$ eigenfunctions drop suddenly at the beginning of the rare-earth group; the binding energy is calculated to be 0·95 eV in lanthanum, $Z = 57$, and 5 eV in neodymium, $Z = 60$. The $5f$ eigenfunctions undergo the same type of change around $Z = 92$. The binding energies were calculated to be 1·35 eV for $Z = 86$, 8·5 eV for $Z = 91$ and 14 eV for $Z = 93$. Author.

2300. Deuteron bombardment of the heavy elements. II. Platinum. R. S. Krishnan and E. A. Nahum. *Proc. Camb. Phil. Soc.*, **37,** *pp.* 422–432, *Oct.*, 1941.—Experiments on the bombardment of Pt with 9 eMV deuterons are reported. Radioactive isotopes of Pt of periods 32 min., 18 hr. and 2·8 days, and isotopes of Au of periods 2·6 and 5·6 days are reported. The 2·6-day Au isotope is formed directly by deuteron bombardment as well as by decay of the 32 min. Pt isotope. The absorption of the β-rays in Al and of the γ-rays in Pb has been measured, and assignments have been made for most of the isotopes reported. Excitation-function measurements have been made for the 32 min. and 18 hr. Pt isotopes, and the form of the energy-yield curve is the same for both these elements. The form of the curve seems to favour the Oppenheimer-Phillips process for the formation of these radioelements by the (^2_1H–^1_1H) reaction. AUTHORS.

2301. New type of disintegration produced by deuterons. R. S. KRISHNAN AND T. E. BANKS. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 317–323, *July*, 1941.—In bombarding Cu, Ag, and Sb with deuterons of energies up to 9 eMV the formation of the radioactive nuclei ^{62}Cu, ^{106}Ag, and ^{120}Sb was observed. From the energy-yield curves the conclusion is drawn that the mechanism of the reaction is the capture of the deuteron by the nucleus and subsequent emission of a hydrogen nucleus of mass 3. R. P.

2302. Disintegration of slow mesotrons. F. RASETTI. *Phys. Rev.*, **60**, *pp.* 198–204, *Aug.* 1, 1941.—The disintegration of mesotrons at the end of their range was investigated by means of an improved arrangement of the type already described [Abstr. 1530 (1941)]. The absorption of a mesotron by a block of Al or Fe is recorded by a system of coincidence and anticoincidence counters. Another system of counters and circuits registers the delayed emission of a particle, which is interpreted as the disintegration electron associated with the absorbed mesotron. The time distribution of the emitted particles, and hence the mean life of the decay process, may be determined independently of the effects produced by the scattering of mesotrons. The mean life is found to be $1{\cdot}5 \pm 0{\cdot}3\ \mu$secs., in agreement with the value deduced from the atmospheric absorption effect. The abs. number of disintegration electrons per absorbed mesotron has also been determined (for an Al absorber) and found to be about ½. This result suggests that, in agreement with theoretical predictions, positive mesotrons undergo spontaneous decay, while the negative ones react with nuclear particles. AUTHOR.

2303. On the Fermi theory of β-radioactivity. II. The "forbidden" spectra. E. J. KONOPINSKI AND G. E. UHLENBECK. *Phys. Rev.*, **60**, *pp.* 308–320, *Aug.* 15, 1941.—Fermi's theory of the energy distribution of β-particles is extended to first and second forbidden transitions for arbitrarily charged nuclei. The calculations are done not only for Fermi's original "polar vector" form of the theory but also for the scalar, tensor, axial-vector and pseudo-scalar forms. The final results are given in the form of a correction factor by which the allowed distribution must be multiplied to give a forbidden spectrum. The energy-dependence of the correction factors was found to be completely independent of the details of the nuclear states only for the scalar and pseudo-scalar interactions and for certain special selection rules in the other interactions. Comparison with experimental data on Na^{24}, P^{32} and RaE, seems to eliminate the scalar, pseudo-scalar and axial-vector possibilities, all of which yield results independent of detailed knowledge concerning the nuclear states involved in these cases. The polar-vector and tensor results depend on the unknown ratio of the magnitudes of certain nuclear matrix elements. Arbitrary adjustment of the unknown ratios allows fairly good fitting of the data. [See Abstr. 3410 (1935)]. AUTHORS.

2304. The γ-radiation from long-lived Yt. J. R. RICHARDSON. *Phys. Rev.*, **60**, *pp.* 188–190, *Aug.* 1, 1941.—The γ-radiation emitted by the 100-day Yt isotope has been investigated. The momentum distribution of the recoil electrons from a thin paper radiator situated near the centre of a cloud chamber falls into 2 groups. These groups correspond to γ-ray energies of $0{\cdot}95 \pm 0{\cdot}05$ eMV and $1{\cdot}92 \pm 0{\cdot}03$ eMV. The relative number of quanta in the γ-ray lines is 1 : 0·9. Because the energy of one of the lines is ½ that of the other, a coincidence experiment must be done before a level diagram can be drawn with certainty. AUTHOR.

2305. γ-rays from Na bombarded by protons. R. L. BURLING. *Phys. Rev.*, **60**, *pp.* 340–343, *Aug.* 15, 1941.—The intensity of the γ-radiation emitted by Na under proton bombardment has been studied as a function of the energy of the bombarding protons up to 1·9 eMV. Protons were accelerated by a 2 MV pressure-insulated electrostatic generator, and were incident on a thin evaporated film of metallic Na. The γ-ray intensities were measured by means of the counts produced by recoil electrons entering a single glass Geiger-Müller counter which actuated a scale-of-16 and mechanical recorder. Generator voltages were measured by a generating voltmeter, which was calibrated by means of the 0·862 eMV resonance in the F (p, γ) reaction. AUTHOR.

***2306. Apparatus for determination of small quantities of radium.** W. D. URRY AND C. S. PIGGOT. *Amer. J. Sci.*, **239**, *pp.* 633–657, *Sept.*, 1941.—The apparatus here described incorporates the best features of previous designs and has demonstrated its ability to evaluate 1×10^{-14} g. of Ra within an observational period of 20 hrs. Its advantages include high precision, elimination of fluxes and chemical manipulation, automatic compensation of extraneous ionizations, automatic calibration every hr., and continuous recording over any desired number of hrs. The permanent record is made on motion-picture film on which are also recorded all the scales necessary for subsequent calculations. This feature eliminates the necessity for the use of any external measurement and makes evaluation a mere matter of counting. AUTHORS.

RADIATION.

ABSORPTION.

∗**2307. Adjustable infra-red absorption cell for liquids.** E. S. BARR. *Rev. Sci. Instrum.*, **12,** *pp*. 396–397, *Aug.*, 1941.—The device regulates cell thickness by means of a micrometer screw and wedge arrangement. Films of non-volatile liquids are readily prepared to within 1μ, up to about 200μ, without estimation. AUTHOR.

EMISSION.

2308. Production of neutrons by cosmic radiation. S. A. KORFF. *Proc. Amer. Phil. Soc.*, **84,** 5, *pp*. 589–603, 1941.—The present state of knowledge about cosmic-ray neutrons is reviewed. The altitude dependence of the rate of production is investigated, employing neutron counters and the radio-balloon technique. A rate of increase with elevation is found which is equal to that of the soft component. Other experiments are described in which the coincidence between neutrons and showers is observed at 2 elevations, by observing the simultaneous discharge of neutron and shower counters. The calibrations and controls on the experiments are described. It is further shown that a cross-section of less than 10^{-25} cm. sq. will suffice to account for the observed number of neutrons if they are produced by photons. In summary, the altitude dependence, the observed coincidences and the cross section considerations, all point to a production of the neutrons by the soft component presumably by a nuclear photodisintegration process. AUTHOR.

FLUORESCENCE AND PHOSPHORESCENCE.

LUMINESCENCE AND AFTERGLOW.

∗**2309. Photo-electric fluorimeter.** G. F. LOTHIAN. *J. Sci. Instrum.*, **18,** *pp*. 200–202, *Oct.*, 1941.—A description is given of a fluorimeter using 2 photocells in a null circuit. The method of use to give greatest accuracy in estimation of the concentration of a fluorescing solution is considered theoretically; it is shown that by working with dilute solutions the effect of impurities may be detected and sometimes be eliminated. AUTHOR.

∗**2310. Supersonic cell fluorometer.** H. B. BRIGGS. *J. Opt. Soc. Amer.*, **31,** *pp*. 543–549, *Aug.*, 1941.—A method is described for the measurement of the rise and decay of luminescence in phosphors excited by cathode-ray beams. It is particularly suited to the investigation of phosphors classed as fast, i.e. those in which major changes in intensity occur in a few μsecs. The method is based on the use of a supersonic cell arranged to produce the Debye-Sears diffraction effect. High-speed shutter action is obtained by modulating the supersonic wave train to produce short steep-sided pulses. Light intensities sufficient for direct measurement in terms of photoelectric cell response are obtained by synchronizing the periodic excitation of the phosphor with the diffracting wave pulses in the liquid. Time intervals in the decay process are measured in terms of distances traversed by the sound waves in water. Several methods of using the device are described, and some results obtained by these methods are shown. AUTHOR.

2311. Mechanism of reactions involving excited electronic states. II. Some reactions of the alkali metals with H. J. L. MAGEE AND T. RI. *J. Chem. Phys.*, **9,** *pp*. 638–644, *Aug.*, 1941.—Some chemiluminescent and quenching reactions of the alkali metals are considered. The reaction which leads to the luminescence of Na in atomic H is seen to be adiabatic, and a model potential-energy surface, constructed by the semi-empirical method, is found to be in qualitative agreement with the experimental observations. The lowest electronic states of the system Na^*H_2 are considered in an attempt to understand the mechanism of the non-adiabatic reaction which quenches the sodium *D* line. It is shown that 2 crossing points should occur, one of them involving a polar state. The rate of the quenching reaction is discussed in terms of the absolute reaction rate theory. [See Abstr. 3035 (1940)]. AUTHORS.

See also Abstracts 2328, 2436.

INTERFERENCE, DIFFRACTION AND SCATTERING.

2312. Angular distribution of light scattered in liquids. L. H. DAWSON AND E. O. HULBERT.

J. Opt. Soc. Amer., **31**, *pp.* 554–558, *Aug.*, 1941.—With a Macbeth illuminometer and a Nicol prism measurements were made of the intensities of the polarized components of the light from a tungsten lamp, scattered at angles from 22½° to 157½° in ethyl ether, carbon tetrachloride, carbon disulphide, benzene and water. All of the liquids were fairly, but not completely, free of optical impurities. The observations were found to agree with the theory that the scattering centres in the liquids scattered in the manner of particles, small with respect to the wavelength, with an additional scattering independent of direction and state of polarization, the amount of the additional scattering depending on the liquid. Deviations from the theory were such as would be accounted for by the optical impurities. For water strong forward scattering was observed, obviously due to the visible motes. AUTHORS.

2313. Studies of the chemical durability of glass by an interferometer method. D. HUBBARD AND E. H. HAMILTON. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 143–157, *Aug.*, 1941.—An interferometer method for determining the chemical durability of glass has been tried on a series of typical glasses over a wide range of temperature and *p*H. The results emphasize the importance of careful temperature control if comparisons are to be made between the findings of different investigators. The relations between amount of attack and *p*H for some of the glasses show pronounced inflections near *p*H 7 in the presence of Britton universal buffer, while the attack by distilled water for these same glasses is very slight in comparison. Moreover, the results strongly emphasize the fact that there can be no single test by which the durability of glass can be judged with respect to all conditions of service. The method has proved particularly useful in the interpretation of known voltage anomalies of the glass electrode. AUTHORS.

See also Abstracts 2320, 2401, 2402.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2314. Photolysis of acetone in presence of mercury. K. W. SAUNDERS AND H. A. TAYLOR. *J. Chem. Phys.*, **9**, *pp.* 616–625, *Aug.*, 1941.—The photolysis of acetone in the region 2 600–2 900Å has been studied at temperatures from 100°–275°C., alone, in presence of liquid Hg, Hg vapour and Hg dimethyl. From a comparison of the products formed in each case and the effect of temperature a mechanism is suggested which indicates that Hg methyl, if not Hg dimethyl, is formed by reaction between methyl radicals and Hg atoms suggesting a greater stability of the Hg methyl radical than hitherto believed. AUTHORS.

2315. Latent-image distribution. W. F. BERG, A. MARRIAGE AND G. W. W. STEVENS. *Kodak Res. Lab. Commun. No. H794. J. Opt. Soc. Amer.*, **31**, *pp.* 385–394, *May*, 1941. *Photogr. J.*, **81**, *pp.* 413–421; *Disc.*, 421–424, *Sept.*, 1941.—The distribution of the latent image between the surface and the interior of the emulsion grains was studied by the use of (*a*) "surface developers" affecting only grains carrying a surface latent image, (*b*) "bleachers" which dissolve only the surface latent image leaving the internal latent image relatively unaffected, and (*c*) "internal developers" which etch away the surface of the grains and bring the internal latent image to development. Reciprocity-law failure was found to occur in opposite senses for surface and internal developers. The result is explained as due to the latent image being formed to an increasing extent in the interior of the grains as the exposure time is decreased. The same explanation is used to account for the Clayden effect and for a reversed Clayden effect observed when internal instead of surface development is applied. Other experiments show that exposures at low temperatures yield a large amount of internal image and that solarization occurs for the surface image only. W. S. S.

2316. Comparison of graininess and speeds of different types of photographic films. C. E. BARTHEL, JR. *J. Opt. Soc. Amer.*, **31**, *pp.* 513–520, *Aug.*, 1941.—Graininess and speed of commercial films developed in typical fine-grain developers were determined quantitatively. The differences in graininess produced by the developers were small in comparison with the inherent differences among the various films. Certain fine-grain developers were effective in reducing the graininess of fast, coarse-grain emulsions, but only at the sacrifice of effective emulsion speed. These developers, however, were only slightly effective in reducing the graininess of slow, fine-grain emulsions, small differences in density or contrast completely obscuring the effects of the developers. AUTHOR.

2317. High-speed photography and its application to industrial problems. E. D. EYLES. *J. Sci. Instrum.*, **18**, *pp.* 175–184, *Sept.*, 1941.—A survey article which reviews the historical development of the subject and discusses the apparatus and technique. The modifications for various speeds are described and numerous examples of the uses of the technique are given. A. H.

PHOTOMETRY.

∗2318. Criticism and improvements of grey-wedge photometers. W. HECHT AND W. MÖRIKOFER. *Met. Z.*, **56**, *pp.* 142–149, *April, and pp.* 186–193, *May*, 1939. *In German.*—The errors in measurements with the grey-wedge photometer [Abstr. 140 (1912)] when used for determining the total intensity of illumination of diffuse daylight may attain 25% or even more. By determining a certain degree of blackening of the unfixed test slip in a specially designed reading device used in a dark-room the average error may be reduced to 8–9%. The authors advocate the calibration of the photometer in calories. R. N.

***2319. Physical photometer.** R. P. Teele. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 217–228, *Sept.*, 1941.—A physical photometer has been constructed, consisting of a thermophile, a potentiometer and a filter which has at each wavelength a transmission proportional to the ICI luminosity factor for that wavelength. This photometer gives results which are consistent with the ICI luminosity factors and which are more accurate than those obtained by visual observers when the photometric fields are not colour-matched. Author.

POLARIZATION.

2320. Scattering of polarized light in colloids. D. Singh. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 481–486, *Nov.*, 1940.—The depolarization of transversely scattered light by colloids having different particle size and shape is investigated with incident light polarized in any azimuth. The results are compared with the depolarization factor calculated from an expression connecting ρ_v, ρ_h and ρ_θ, where θ is the azimuthal angle. The divergence between the calculated and observed values is small for benzene and acetic acid and arsenious sulphide sol but becomes greater with increasing particle size and anisotropy. This is clearly demonstrated by graphite sols centrifuged for various intervals of time. The observed deviation is explained as due partly to the influence of secondary scattering and partly to the assumption of incoherence between the different types of scattering not being strictly valid for large anisotropic particles. Author.

REFLECTION, REFRACTION AND DISPERSION.

2321. Spectral character of the reflection by a regularly stratified medium. I. R. V. Subrahmanian. *Proc. Indian Acad. Sci. A.*, **13**, *pp.* 467–482, *June*, 1941.—By application of the electromagnetic theory of light an expression is derived for the intensity of light reflected from a regularly stratified medium. The intensity and spectral character of the reflected light is computed and discussed for a variety of cases. For small values of the reflecting power the primary band consisting of the wavelengths selectively reflected is sharply defined and accompanied on the longer-wavelength side by a number of secondary bands of gradually decreasing intensity. With a reduction in the number of laminae, the sharpness of the band remains practically unaffected, though the general intensity falls. Below this limit the band begins to broaden. For a given number of plates the bands are more sharply defined for smaller values of the reflecting power, though the intensity of the reflected light is smaller. Some secondary bands begin to appear on the shorter-wavelength side, when the reflecting power is sufficiently large. Further, it is shown that, when the reflections from the successive surfaces agree in phase, the smaller the relative thickness of the alternate strata, the larger the number of plates required for complete reflection. Author.

2322. Effect of lattice strain on the reflectivity of silver. Y. Kidani. *Mem. Ryoj. Coll. Engng*, **14**, *pp.* 15–30, *Feb.*, 1941.—The shifting of the wavelength of min. reflectivity of Ag by mechanical and heat treatments involving lattice strain and recrystallization has been investigated. The min. was displaced to longer wavelengths by tensile strain, annealing or etching, and to shorter wavelengths by compression or polishing. Plastic deformation does not affect the position of the min. The effect of depositing Ag on base metal surfaces was also studied. For an Ag film deposited on Cu the min. was displaced to shorter wavelengths because of the compression effect exerted on the Ag lattice by the smaller Cu lattice. A formula giving the effect of strain on the position of the min. was deduced on the basis of statistical mechanics. The annealing of a sputtered Ag film was investigated, the recrystallization being followed by determining the resistance of the film, and by microscopic examination. The min. of the reflectivity of the sputtered film on quartz was examined. The film was usually amorphous, but, on annealing, the min. was displaced to longer wavelengths the higher the temperature of annealing. A. J. M.

2323. Analysis of optical systems. O. H. Clark and S. Rosin. *J. Opt. Soc. Amer.*, **31**, *pp.* 394–401, *May*, 1941.—Explicit expressions for the focal lengths and cardinal points of a system of *n* coaxial components were given in a previous paper [Abstr. 1565 (1941)]. By applying Taylor's theorem expressions are derived for the changes in these quantities when one or more of the parameters of the system are varied. The expressions are exact for changes of a single parameter or for simultaneous changes of 2 component separations or of a separation and a component focal length. The work is illustrated by calculations on the Steinheil telescope objective, Gullstrand's schematic size and the Bis-Telar telephoto lens. W. S. S.

2324. Refractive index of paraffins in terms of the number and frequency of the dispersion electrons. S. S. Kurtz, Jr. and M. R. Lipkin. *J. Amer. Chem. Soc.*, **63,** *pp.* 2158–2163, *Aug.*, 1941.—The modified Sellmeier-Drude equation $n^2 - 1 = B/\{(V_0 + \phi)^2 - V^2\}$ is used to correlate refractive-index density and data for both normal and average paraffins. It is shown that there is approx. 1 dispersion electron per formula bond, and that the frequency is linear with the density in any homologous series. The refractive index of normal paraffins can be calculated within $\pm 0{\cdot}000\,2$ and the refractive index of average paraffins within $\pm$ 0·000 5. Refractive index of paraffins can be calculated for any wavelength of light, and for any temperature or pressure, provided the corresponding density is known. The significance of the ϕ coefficient is briefly discussed. The relationships between frequency V_0, energy in ergs, and wavelength in Å, corresponding to bonds in the normal paraffin homologous series are shown graphically. For any one paraffin the shift in frequency and wavelength caused by change in density is appreciable. Authors.

2325. Connection between diminution of refraction and reduction of susceptibility in crystal lattices and in molecules. T. Neugebauer. *Ann. Phys., Lpz.*, **39,** 4, *pp.* 241–260, *April*, 1941. *In German.*—In both cases the wave equation of a double perturbation problem is involved, the one perturbance arising from the field of the neighbouring ions and the other from the field of the light wave or the external magnetic field. In the case of the refraction decrease the second approximation of the eigenfunction has to be used, whereas only the first is required for the decline in susceptibility; the quantum-mechanical cause of this is discussed. A simple method is indicated by which the formulae obtained can be applied to multi-electron problems. In conclusion the refraction of the HCl molecule is calculated with the aid of the new Hartree tables [Abstr. 3490 (1936)]. H. G. S.

SPECTROSCOPY.

2326. The Lundegardh flame method of spectrographic analysis. V. R. Ells. *J. Opt. Soc. Amer.*, **31,** *pp.* 534–542, *Aug.*, 1941.—A description of the method as used at the University of Missouri for analysis of soils and plant materials. Details are given of the technique and of the elements that can be handled. A. H.

***2327. Direct reading microphotometer.** G. O. Langstroth, K. B. Newbound and W. W. Brown. *Canad. J. Res. A*, **19,** *pp.* 103–108, *July*, 1941.—A convenient self-contained instrument suitable for the direct measurement of spectrographic plates of size 10 in. × 4 in. includes a lamp and optical system, a Weston photronic photocell and a reflecting galvanometer. A chart with semi-log paper can be mounted alongside the galvanometer scale and deflections traced directly without reading the scale. Precision adjustment of the plate holder is possible, as well as for initial adjustments of the optical system. E. H. W. B.

2328. Studies of the afterglow in mercury vapour. I. Intensity/pressure relations. II. Spectral intensity distribution. R. C. Garth and G. E. Moore. *Phys. Rev.*, **60,** *pp.* 208–224, *Aug.* 1, 1941.—The intensities of the stronger lines in the subordinate series of the afterglow spectrum of Hg were measured by photographic methods as functions of vapour pressure from 0·1 mm. to 2·0 mm. Hg in a stream of vapour distilled from a Hg arc into a side tube. Measurements made with the ion concentration held constant at the point of observation showed that increasing the pressure increased the intensity of a given line and caused a marked change in intensity distribution in a given series. At constant pressure the intensities varied approx. linearly with ion concentration. The introduction of fast electrons into the stream quenched the line spectrum of the afterglow. Quenching also resulted from removal of positive ions. The results indicate that the line spectrum of the afterglow is produced by a complex recombination process in which collisions with neutral atoms are important. Diffuse bands, attributable to molecules, each composed of a neutral atom and an atom in one of the $6^3P_{0,1,2}$ states, were observed under certain conditions.—By measuring the abs. intensity of the group of lines 3 650–3 663 Å radiated by 1 cm.^{3} of the vapour, the abs. intensities of these lines were determined and the total number of quanta radiated per sec. from unit vol. calculated. From these results and from the measured rate of change of the positive-ion concentration near the point of observation it was shown that the total number of quanta radiated per sec. was too great to be accounted for by assuming the afterglow to be produced by simple recombination of ions and electrons. Furthermore, a comparison of the number of quanta entering each atomic state by radiative transitions with the number similarly leaving this atomic state showed that the average energy possessed by the excited atoms emitting the line spectrum was about 9 eV. These results can best be explained by assuming that molecular particles with a mean life of about 10^{-3} sec. are formed by multiple impacts between the atomic ions, produced in the arc, and neutral Hg atoms, and that these particles dissociate to produce the excited atoms which radiate the afterglow. Some of the observed properties of the afterglow, especially the dependence of the intensity upon the pressure, are well accounted for by the assumption that this molecular particle is the excited molecule proposed by Arnot and Milligan. AUTHORS.

2329. Spectra of A in the extreme ultra-violet. L. W. PHILLIPS AND W. L. PARKER. *Phys. Rev.*, **60**, *pp.* 301–307, *Aug.* 15, 1941.—A simple method for the excitation of spectra of higher stages of ionization of rare gases is described. Applied to A, the method has yielded spectra of all stages of ionization from A III to A IX. Classified lines in the extreme ultra-violet and term tables for the ions V to IX are given. Some minor additions and corrections to previous analyses of Cl IV and Cl VI are pointed out. AUTHORS.

2330. Vibration-rotation energies of the planar XY_3 molecular model. S. SILVER AND W. H. SHAFFER. *J. Chem. Phys.*, **9**, *pp.* 599–606, *Aug.*, 1941.—The vibration-rotation energies of the planar XY_3 molecular model are investigated to the second order of approximation, including the cubic and quartic anharmonic terms of the potential energy, the Coriolis interactions between the degenerate oscillations and the total angular momentum, the dependence of the moments of inertia upon the vibrational state, and the centrifugal expansion terms. The contact transformation developed by Shaffer, Nielsen and Thomas, is applied to the Wilson-Howard Hamiltonian, and it is found that the energies are simply the diagonal elements of the transformed Hamiltonian. The dependence of the moments of inertia, I_{xx} and I_{zz}, upon the vibrational states is determined, and it is found that the quantity $\Delta = I_{zz} - 2I_{xx}$ is independent of the anharmonic constants, depending only on the dimensions of the molecule, the normal frequencies, and the vibrational state. AUTHORS.

2331. Rotation-vibration energies of the pyramidal XY_3 molecular model. W. H. SHAFFER. *J. Chem. Phys.*, **9**, *pp.* 607–615, *Aug.*, 1941.—Complete expressions have been derived for the rotation-vibration energies of the pyramidal XY_3 molecular model in such a way as to include, through second order of approximation, all contributions to the energies arising from Coriolis interactions, anharmonicities, etc. AUTHOR.

2332. Vibrational analysis of absorption system of SO_2 at λ3 400–2 600. N. METROPOLIS. *Phys. Rev.*, **60**, *pp.* 295–301, *Aug.* 15, 1941.—Photographs of the absorption bands have been taken under low, medium and high dispersion, both at room temperature, and at 200°K.; the pressure of the absorbing gas was varied from 0·3 mm. to 480 mm. The results indicate that both the bond distance and the angle change considerably in the transition to the excited electronic state. The vibrationless transition at 29 622 cm.$^{-1}$ is weak, as one would expect from considerations of the Franck-Condon principle. The absence of any regularity in the rotational structure supports the conclusion that the molecule in its upper state has become a more asymmetrical top. AUTHOR.

2333. On the continuous emission spectra associated with electric discharges through flowing vapours of $SnCl_2$, $SnCl_4$ and $SiCl_4$. R. K. ASUNDI, S. M. KARIM AND R. SAMUEL. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 513–518, *Dec.*, 1940.—From the experimental conditions under which the spectra are obtained it is assumed that they are due to molecular radiation. Thermochemical and spectroscopic data enable one to illustrate the relation between the energy levels of the various systems in the formation of the multi-atomic molecules from their constituent atoms. Such simplified Franck-Condon diagrams are constructed for $SnCl_4$ (which includes $SnCl_2$) and $SiCl_4$. An interpretation, uniform in all cases, of the observed continuous bands in terms of the transitions between the energy levels, transitions which involve a repulsive state for their final level, is suggested. AUTHORS.

2334. Absorption spectra and constitution of derivatives of chlorophyll. II. F. PRUCKNER. *Z. phys. Chem. A*, **187**, *pp.* 257–275, *Nov.*, 1940. *In German.*—[See Abstr. 5349 (1937)]. A comparison is made between the absorption spectra of porphyrines, chlorines and bacteriochlorines with regard to influence of solvents, width of band, height of band and degree of molecular symmetry. Present experimental results are insufficient for establishing the constitutional formulae proposed. Investigations on rotatory dispersion are advocated. R. N.

2335. Infra-red spectrum of glutaric acid and the oscillating properties of chain molecules. M. WEHRLI AND R. FICHTER. *Helv. Phys. Acta*, **14**, 3, *pp.* 189–194, 1941. *In German.*—The spectrum of crystalline glutaric acid was investigated in the wave-number range 680–3 800 cm.$^{-1}$ by means of a specially constructed spectrometer which is described. Most of the bands can be assigned to normal modes or group frequencies of the crystalline molecule. The frequencies of 800–1 000 cm.$^{-1}$, which have been reported from investigation of the Raman spectra of liquids with carbon chains, are found in the infra-red spectrum of glutaric acid, and it is concluded that they are typical properties of chain vibrations of such molecules. W. R. A.

2336. Band spectra of $TlCl_3$. E. MIESCHER. *Helv. Phys. Acta*, **14**, 3, *pp.* 148–162, 1941. *In German.*—By using greater dispersion for the emission and absorption spectra of $TlCl_3$ a more detailed analysis of the ultra-violet $TlCl_3$ bands was made. These bands show anomalous intensity distributions which are due to radiationless transitions. The spectra of $TlCl_3$ of normal and of enriched ^{37}Cl content are compared and the isotope splitting of Cl and the isotope doublet of Tl have been observed. In the violet region the emission spectra of different types of discharge in $TlCl_3$ vapour show an additional band spectrum due to Cl isotope splitting. W. R. A.

2337. Spectral energy distribution in sunlight and skylight. E. Elvegård and G. Sjöstedt. *Illum Engng, N.Y.*, **36,** *pp.* 767–785, *July*, 1941.—After a consideration of the various determinations of the spectral energy distribution of sunlight the authors conclude that the colour temperature of extra-terrestrial sunlight is 5 970°K. For sunlight at the earth's surface they propose the adoption of a "normal" energy distribution curve defined for a 45° solar altitude and a specified dust content of the air. This curve is given and it does not depart very greatly from the Wien curve for a temperature of 4 850°K. There is a full Bibliography. J. W. T. W.

2338. Paschen-Back effect. VIII. Reality of distant components. J. B. Green. *Phys. Rev.*, **60,** *pp.* 343–344, *Aug.* 15, 1941.—The He line λ 7066 has been investigated in order to show that the distant components, whose predicted intensities are extremely small, really do exist. Agreement between theory and experiment, as regards both position and intensities of these components, is excellent. [See Abstr. 2751 (1936)]. Author.

2339. Zeeman effect of the forbidden lines of Pb I. II. An interference effect in the mixed line, λ7 330. F. A. Jenkins and S. Mrozowski. *Phys. Rev.*, **60,** *pp.* 225–233, *Aug.* 1, 1941.—[See Abstr. 1585 (1941)]. The transverse Zeeman effect of this line, which contains mixed magnetic dipole and electric quadrupole radiation, is investigated with a Fabry-Perot interferometer and with magnetic fields up to 4 000 gauss. The pattern obtained is in agreement with expectations. Quantitative intensity measurements of all components are reported. In the σ pattern the sum of the intensities of the 4 outer electric quadrupole components is found to be 0·02 of the 3 central magnetic dipole components. The relative intensities of the latter and of the π components agree with the theory of Gerjuoy [Abstr. 2340 (1941)] provided that the intensities contributed by the Zeeman components of the hyperfine structure are taken into account. These components are investigated at various magnetic fields, and the development of the Back-Goudsmit effect is verified. Comparison with theory indicates $2{\cdot}2 \pm 0{\cdot}5\%$ of quadrupole radiation and proves that interference exists between the two types of radiation. Authors.

2340. Interference in the Zeeman effect of forbidden lines. E. Gerjuoy. *Phys. Rev.*, **60,** *pp.* 233–240, *Aug.* 1, 1941.—The predicted intensity of any Zeeman component includes a term dependent on the fact that both modes of radiation are possible, as well as the usual transition probabilities for independent electric quadrupole and magnetic dipole radiation. Such additional interference terms appear only in the Zeeman effect and not in total line intensities. Proofs of these assertions and formulae for the Zeeman intensities are developed. The latter are compared with obersvations by Jenkins and Mrozowski [Abstr. 2339 (1941)]. Good agreement with experiment is obtained only if interference is taken into account. A brief discussion of the hyperfine structure of forbidden lines is included, in which it is shown that the rules for determining the relative intensities of electric dipole hyperfine multiplets also give the intensity ratios in the hyperfine structure of magnetic dipole lines. Author.

2341. Zeeman effects in the Pd spectrum. C. H. Lindsley and N. Rosen. *J. Opt. Soc. Amer.*, **31,** *pp.* 531–534, *Aug.*, 1941.—Zeeman data for 37 Pd I lines and 127 Pd II lines are given, based on measurements of Zeeman patterns photographed at M.I.T. in a magnetic field of about 87 500 gauss; *g*-values for the energy levels arising from the $4d^95s$ and $4d^95p$ configurations of Pd I and the $4d^85s$ and $4d^85p$ configurations of Pd II are presented. Authors.

2342. Raman spectrum of di-tertiary-butyl ether. F. F. Cleveland. *J. Chem. Phys.*, **9,** *pp.* 722–724, *Sept.*, 1941.—Raman displacements, estimated intensities and depolarization factors, are listed for di-tertiary-butyl ether, $(CH_3)_3COC(CH_3)_3$, in the liquid state and the results are compared with previous data for di-normal-butyl and di-isobutyl ethers. A tentative assignment of the observed lines to frequencies of the di-tertiary-butyl ether molecule is made.

2343. Raman spectra of mono- and dichlorobenzenes. H. Sponer and J. S. Kirby-Smith. *J. Chem. Phys.*, **9,** *pp.* 667–672, *Sept.*, 1941.—Raman spectra were taken of gaseous mono- and dichlorobenzenes. Polarization measurements were made for the dichlorobenzenes in the liquid phase. Interpretations of the stronger lines are given in terms of modes of vibration. Authors.

2344. Slit-width correction in objective spectrophotometry. T. Murakami. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 227–239, *March*, 1941. *In German.*—The curvature of spectral lines and their intensity distribution in the lengthwise direction are considered and a formula is derived. Numerical examples for rectilinear and curved slits are worked out. W. R. A.

X-RAYS.

2345. Anomalous reflections in X-ray patterns. G. D. Preston. *Proc. Roy. Soc. A*, **179,** *pp.* 1–7, *Aug.* 29, 1941.—A brief summary of the author's previous work on the diffuse anomalous reflections first noticed on Laue photographs. They are attributed to thermal vibrations although the exact mechanism by which they are produced is not understood. The positions and intensities of the reflections are, however, not inconsistent with the idea that they are due to diffraction by small groups of atoms. The relationship between the author's results and the theory of Faxen are discussed, but although a formula derived by the latter is confirmed, it is felt that the viewpoint that the reflections in question are to be regarded as abnormal, to be explained by means of a modified Bragg law, is incorrect. J. T.

2346. The diffuse spots in X-ray photographs. W. H. Bragg. *Proc. Roy. Soc. A*, **179,** *pp.* 51–60, *Aug.* 29, 1941.—Considers that the diffuse spots are due to diffraction by small groups of atoms which act independently and are in slight disarray with the crystal as a whole; and shows how well the actual results agree with this in the cases of KCl, diamond and calcite. J. T.

2347. Diffraction of monochromatic X-rays by crystals at high temperatures. W. L. Bragg. *Proc. Roy. Soc. A*, **179,** *pp.* 61–64, *Aug.* 29, 1941.—Considers that the explanation of the existence of diffuse spots as being due to the presence of small parallel elements in the crystal, diffracting independently, cannot be a complete explanation, since, if the crystal were broken up by heat waves, as supposed, the Laue spots and the spots of rotation photographs would also be diffuse, which is not the case. An explanation is afforded by considering the clouds which may be supposed to surround the points of which the reciprocal lattice of a crystal consists, and by taking account of the phase relationships between waves scattered by the atoms throughout the crystal. J. T.

2348. Diffuse reflections of X-rays by crystals. G. I. Finch. *Proc. Roy. Soc. A*, **179,** *pp.* 67–68, *Aug.* 29, 1941.—Compares the diffuse pattern obtained with X-rays to that observed in the case of electron diffraction. In the latter case the diffuse pattern is directly associated with the orientation of the individual molecules, but in the former this does not appear to be true. J. T.

2349. New technique for making thin targets. L. T. Pockman and D. L. Webster. *Rev. Sci. Instrum.*, **12,** *pp.* 389–392, *Aug.*, 1941.—Describes a new technique for preparing thin Ni targets ranging upward in thickness from 10^{-6} cm. The targets are approx. 10 cm.^{2} in area and are backed by films of cellulose acetate $5 \cdot 10^{-6}$ cm. thick. The periphery of the target is supported by a flexible array of fine wires. Authors.

HEAT.

CALORIMETRY.

2350. Heat capacity of glucose glass. E. W. Nelson and R. F. Newton. *J. Amer. Chem. Soc.*, **63,** *pp.* 2178–2182, *Aug.*, 1941.

2351. Heat capacities and entropies of 3 disaccharides. A. G. Anderson and G. Stegeman. *J. Amer. Chem. Soc.*, **63,** *pp.* 2119–2121, *Aug.*, 1941.

2352. Heat capacities and entropies of 2 monosaccharides. G. W. Jack and G. Stegeman. *J. Amer. Chem. Soc.*, **63,** *pp.* 2121–2123, *Aug.*, 1941.

2353. Heat capacity and entropy, heats of fusion and vaporization, and the vapour pressure, of dimethyl ether. The density of gaseous dimethyl ether. R. M. Kennedy. M. Sagenkahn and J. G. Aston. *J. Amer. Chem. Soc.*, **63,** *pp.* 2267–2272, *Aug.*, 1941.

2354. Change in specific heat on melting. I. Osida. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 205–207, *March*, 1941.—On the basis of Mott's equation [Abstr. 4298 (1934)] it is shown that when T_m, the melting point, is greater than or equal to Θ_s, the Debye characteristic temperature for the solid, the sp. hts. of solid and liquid are nearly equal and satisfy the Dulong-Petit law. When $T_m < \Theta_s$, as for H_2 and H_2O, the sp. ht. of the liquid considerably exceeds that of the solid and there are marked deviations from the Dulong-Petit law. R. W. P.

2355. The heat capacities of molecular lattices. I. Introduction. II. The structure of metallic Li. R. C. Lord, Jr. *J. Chem. Phys.*, **9,** *pp.* 693–705, *Sept.*, 1941.—The assumption is made that the lattice part of the molecular heat capacity can be represented by a single Debye function with the appropriate number of degrees of freedom. The reasons for this assumption are considered, and it is shown that its validity can be expected except at temperatures low in comparison with the characteristic temperature of the Debye function. The conversion of C_v to C_p is discussed for molecular lattices.—The failure of the Debye equation for atomic lattices to hold for the heat capacity of metallic Li is attributed to the association of Li atoms in the crystal into diatomic ions. It is shown that the heat capacity can be understood without postulating a breakdown of the Debye theory. Author.

See also Abstracts 2385, 2416.

CONVECTION.

2356. Heat transfer and superfluidity of helium II. P. L. Kapitza. *Phys. Rev.*, **60**, *pp.* 354–355, *Aug.* 15, 1941.

2357. Theory of the superfluidity of helium II. L. Landau. *Phys. Rev.*, **60**, *pp.* 356–358, *Aug.* 15, 1941.

DILATATION.

2358. Dilatometric study of the order-disorder transformation in Cu-Au alloys. F. C. Nix and D. MacNair. *Phys. Rev.*, **60**, *pp.* 320–329, *Aug.* 15, 1941.—Plots of true coeff. of thermal expansion *v.* temperature for previously well-ordered alloys display a slow rise from − 190° to about + 50°C., followed by a flat plateau to about 250°C. From the flat plateau they rise rapidly to a peak at the critical ordering temperature T_c, followed by a fall to a second flat plateau which extends to at least 450 deg. C. above T_c. The portion below the flat plateau can be represented by a Grueneisen equation if one assumes additivity for the constants taken from the equation for the pure metals Cu and Au. The presence of the flat plateau above T_c is in disagreement with Bethe-Peierls's theory of the vanishing of short-range order. Plots of true coeff. of expansion *v.* temperature, for specimens previously quenched from above T_c, display valleys similar to those in the comparable sp. ht. curves of Sykes and Jones. Authors.

2359. Glass-to-metal seals. II. A. W. Hull, E. E. Burger and L. Navias. *J. Appl. Phys.*, **12**, *pp.* 698–707, *Sept.*, 1941.—A continuation of previous work [Abstr. 367 (1935)]. The greater part of the paper is devoted to a discussion of the properties of Fe-Ni-Co alloys, especially the composition Fe 54%, Ni 31%, Co 15%, including sensitiveness to impurities and polymorphism. Three new glass-metal combinations are described, the metals being 42% Ni-Fe, 26% Cr-Fe, and pure Fe, respectively. The strength of the glass-metal bond is discussed briefly. Authors.

2360. Contribution of the conduction electrons in a metal to the thermal expansion. Z. Mikura. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 309–318, *April*, 1941.—Calculations show that the conduction electrons give a contribution to the thermal expansion coefficient of a metal which is proportional to the abs. temperature and therefore should become appreciable at very low temperatures where the contribution of lattice vibrations decreases as T^4. The ratio between the expansion coefficient and the electronic sp. ht., which is also proportional to T, is not the same as that in Gruneisen's formula giving the proportionality between the expansion coeff. and sp. ht. at ordinary temperatures. R. P.

2361. Thermal expansion of clay building bricks. C. W. Ross. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 197–216, *Aug.*, 1941.—The coefficients of thermal expansion of 139 bricks were measured over the range − 10° to + 40°C. (14° to 104°F.). These bricks included 1 sample of sand-lime, 9 of fire-clay, and 61 of clay and shale bricks. The clay and shale bricks represented a wide range in properties and included samples from various districts in the U.S. No relation was observed between the thermal expansion and the other physical properties of the bricks. Author.

2362. Thermal expansion of cast and of swaged chromium. P. Hidnert. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 113–124, *Aug.*, 1941.—Data were obtained on the linear thermal expansion of 6 samples of Cr (99·2 to 96·3%) at various temperatures between − 190° and + 707°C. The expansion curves indicated anomalies at low temperatures. These anomalies were reversible on heating and cooling. The temperature at which anomalous expansion occurs appears to decrease with decrease in the purity of the Cr. Hysteresis was not observed on heating cast or swaged Cr to 300°C. and cooling to low temperatures. Exceptionally low average coeff. of expansion were found for temperature ranges in or near the anomalous regions. The average coeff. of expansion of the samples of Cr from 20°C. to various temperatures between 100° and 700°C. lie between $5\cdot7 \times 10^{-6}$ and $10\cdot3 \times 10^{-6}$/deg. C. Author.

See also Abstract 2416.

FUSION AND SOLIDIFICATION.

2363. Theory of fusion. M. Toda. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 252–263, *March*, 1941.—A discussion of the equation of state for a solid which shows that the change in ν, the frequency of atomic vibration, on melting as given by Mott's formula [Abstr. 4298 (1934)] must be due to the occurrence of some structural change. A theory of fusion is then suggested in which the assumption is made that ν depends on the degree of order. R. W. P.

See also Abstracts 2354, 2369.

THERMOCHEMISTRY.

2364. Temperature dependence of the reactions of chloro-, bromo- and iodo-ethanoic acid with water. F. Kunze and H. Merkader. *Z. phys. Chem. A.*, **187**, *pp.* 285–288, *Nov.*, 1940. *In German.*—The temperature dependence is determined and the activation heat and the activity constant are calculated. The activity constants have the same ratio as the quantum yields of the same reactions in ultra-violet light. An explanation is given. R. N.

2365. Heats of isomerization of the 5 hexanes. E. J. R. Prosen and F. D. Rossini. *Bur. Stand. J. Res., Wash.*, **17**, *pp.* 289–310, *Sept.*, 1941.—A procedure is outlined and utilized for determining with high precision the ratios of the heats of combustion, and hence the heats of isomerization, of the 5 hexanes. In principle, the ratio of the heats of combustion of any 2 isomers was determined as the inverse ratio of the masses of CO_2 whose formation in the combustion of the respective hexanes produced identical increases of temperature in the calorimeter system, measured as an increase in the resistance of the Pt resistance thermometer. Authors.

2366. The thermal reaction between hydrogen and oxygen. IV. Comparison of the thermal and the photochemical reaction. O. Oldenberg and H. S. Sommers, Jr. *J. Chem. Phys.*, **9**, *pp.* 573–578, *Aug.*, 1941.—Some recent observations are compared with theories of the thermal and the photochemical reaction between H and O. For both cases the gas phase reaction observed at higher temperatures is best described by the Bonhoeffer-Haber chain. [See Abstr. 1608 (1941)]. Authors.

2367. The reaction between hydrogen and oxygen: kinetics of the third explosion limit. H. R. Heiple and B. Lewis. *J. Chem. Phys.*, **9**, *pp.* 584–590, *Aug.*, 1941.—The third explosion limit of H and O has been investigated in spherical pyrex vessels of different sizes, covered with an almost invisible layer of KCl, at temperatures from 530° to 570°C., using different ratios of H and O, and inert gases, Ni, He, and A. The results are described by the mechanism developed by Lewis and von Elbe from experiments at the second explosion limit and the reaction above it. The explosion is preceded by an induction period, which decreases to zero at higher pressures. It is shown that such third-limit explosion pressures of zero induction period are representative of the isothermal branched chain explosion, whereas lower third-limit explosion pressures with induction periods have a thermal disturbance superimposed, the difference between the two values providing a measure of the magnitude of the thermal effect. From the energy of activation of k_2 for reaction $H + O_2 = OH + O$, determined at the second explosion limit, and the slope of the third explosion limit curve with temperature determined by Oldenburg and Sommers in a heavily KCl-coated vessel for zero induction period, an energy of activation of k_{10} for the reaction $HO_2 + H_2 = H_2O_2 + H$ was calculated to be 33·5 k.cal. This agrees with the value 32·9 k.cal. found by calculating k_{10} directly from the experimental data. This sets an upper limiting value of the bond energy of H and O_2 in HO_2 as 65·3 k.cal. The energy of H and HO_2 in H_2O_2 then has a lower limiting value of 69·5 k.cal. Authors.

2368. Semi-empirical calculations of activation energies. J. O. Hirschfelder. *J. Chem. Phys.*, **9**, *pp.* 645–653, *Aug.*, 1941.—The predictions of the Eyring semi-empirical scheme for calculating activation energies are compared with the existing experimental data. It is found that in most cases this agreement is satisfactory. However, the experimental data are not sufficiently accurate to make this scheme appear unique. The experimental activation energies seem to be functions only of the binding energies and do not depend in an important way on either the size of the atoms or on the diatomic force constants. If the reaction $a + bc \rightarrow ab + c$ is exothermic, it is found that the activation energy is $0{\cdot}055D'_{bc}$, where D'_{bc} is the energy of the bond *bc*. This formula is derived from the semi-empirical scheme on the assumption that the attraction between the distant atoms *a* and *c* is zero. For exothermic 4-atom reactions $ab + cd \rightarrow ac + bd$, it is found that the activation energy is $0{\cdot}28(D'_{ab} + D'_{cd})$. The numerical factor was adjusted to fit the $H_2 + I_2$ reaction and although, in most cases, this gives activation energies in agreement with the semi-empirical values, no mathematical connection has been made. Author.

THERMODYNAMICS.

2369. Theory of the liquid state. (i) Statistical treatment of the thermodynamics of liquids by the theory of holes. (ii) Application of the hole theory to superheated liquids and supersaturated solutions of gases in liquids. (iii) The hole theory of the viscous flow of liquids. R. Fürth. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 252–290, *July*, 1941.—A theory which embodies the fundamental ideas of an earlier paper [Abstr. 2152 (1939)], but in which the model is so chosen as to make possible a statistical treatment for a liquid analogous to that used for gases. Holes formed in the liquid by the action of irregular thermal movement are regarded as the counterparts of the clusters in a dense gas or vapour, increasing in size and frequency with increase in temperature or with decrease in pressure. The holes are assumed to be filled with vapour saturated at the liquid temperature and to be surrounded with a continuum having the normal surface tension of the liquid. The theory can only give a rough picture of the real behaviour of a liquid, but tabulated results show that the principal thermodynamic properties of the liquid state derived in this way are in general numerical agreement with experiment. The theory leads to the existence of a metastable state of a liquid which is identified with the superheated state, and a similar result holds for the supersaturation of gases. On the assumption that the viscosity of a liquid is due to the transfer of momentum by the irregular movement of the holes, a formula is derived for the absolute value of the viscosity and for its dependence on temperature. There is again agreement with experimental data. R. W. P.

2370. Thermodynamics of N_2–H_2 mixtures. V. Fischer. *Ann. Phys., Lpz.*, **39,** 4, *pp.* 273–280, *April,* 1941. *In German.*—A graphical method is developed to determine the equilibrium concentrations of a 2-component mixture when, with equilibrium between liquid and vapour, temperatures and pressures occur which are above the critical temperature and the critical pressure of the lower b.p. component. The method is applied to the calculation of the equilibrium isotherms of the N_2–H_2 mixture, using the experimental results of Verschoyle [Abstr. 516 (1932)] for the determination of the characteristics of the mixture. H. G. S.

2371. Contributions to the data on theoretical metallurgy. IX. The entropies of inorganic substances. Revision (1940) of data and methods of calculation. K. K. Kelley. *Bull. U.S. Bur. Min., No.* 434, [115 *pp.*], 1941.

2372. Joule-Thomson and Joule effects for Bose-Einstein and Fermi-Dirac gases. B. N. Singh. *Indian J. Phys.*, **14,** *pp.* 459–473, *Dec.*, 1940.—A general formula is obtained for the Joule-Thomson effect for non-degenerate Fermi-Dirac and Bose-Einstein gases. The Joule effect is also dealt with and it is shown that for both effects the Fermi-Dirac gas is invariably heated, whereas the Bose-Einstein gas is cooled. For matter obeying Bose-Enstein statistics the region of transition from degeneracy to non-degeneracy is studied in detail. R. W. P.

2373. Dielectric and solvent effects upon the rate of sucrose inversion by hydrochloric acid. E. S. Amis and F. C. Holmes. *J. Amer. Chem. Soc.*, **63,** *pp.* 2231–2235, *Aug.*, 1941.—An equation relating the energies of activation in iso-composition and iso-dielectric media is derived, and is tested by an investigation of the acid inversion of sucrose in the two types of media using (*a*) C_2H_5OH–H_2O and (*b*) dioxane-H_2O. Results show that, in agreement with the predictions of the equation, the energies of activation are sensibly the same for the two types of media. The influence of dielectric constant on the rates and energies of activation for (*b*) can be accounted for on the basis of electrostatics. The rate and energy phenomena in (*a*) can be explained qualitatively on the basis of formation of $C_2H_5OH_2^+$. ion. The equation gives fair agreement with the observed differences of energies of activation in iso-composition and iso-dielectric media for two types of ionic reactions in various mixed solvents, agreement between observed and calculated values being best when electrostatic corrections were made to make the iso-dielectric energies correspond to the dielectric constant of the iso-composition energies. N. M. B.

See also Abstracts 2254, 2351, 2352, 2353, 2356, 2357, 2363.

VAPORIZATION AND CONDENSATION.

2374. Volatility, vapour pressures and diffusion coefficients of the system novolak-acetophenone. E. Jenkel and J. Komor. *Z. phys. Chem. A*, **187,** *pp.* 335–353, *Dec.*, 1940. *In German.*—The system consisting of the synthetic resin novolak and acetophenone used as a softener was contained in a small box closed with a cover and kept at the constant temperature of 30°C. Through a small opening in the cover the softener evaporated into a vacuum of 10^{-3} mm. Hg. For 100%–70% softener the loss in weight was proportional to the v.p. For smaller percentages the volatility is not determined by the v.p. but by the diffusion coefficient. An explanation and equations are given, the solutions of which furnish a good representation of the experimental results. R. N.

See also Abstract 2353.

ACOUSTICS.

2375. Acoustically effective vortex motion in gaseous jets. P. Savic. *Phil. Mag.*, **32,** *pp.* 245–252, *Sept.*, 1941.—The validity of certain theories of sensitive jets and of edge-tones is discussed. Bickley's formula [Abstr. 1943 (1937)] is inserted into Tollmien's disturbance equation [Abstr. 4845 (1935)], and stream function, wave velocity and wavelength are found. A representation of stream lines shows good qualitative agreement with Brown's photographs of smoke jets [Abstr. 3123 (1935)]. A formula connecting the frequency of the sound with either of the 2 proper values of the disturbance equation is derived. It gives results in agreement with Brown's measurements on edge-tones. A brief explanation of the phenomenon of sensitive jets is given. G. E. A.

2376. Dispersion of sound waves, considering the effects of heat conduction and viscosity. Z. Sakadi. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 208–213, *March*, 1941.—A mathematical analysis in which the following assumptions are made:—(i) the disturbance by the sound wave is very small, so that every quantity differs but little from that of the static state, (ii) there is only 1 excited state and the number of excited molecules is very small compared with that of unexcited molecules. An addendum contains numerical data for CO_2 which show that consideration of conduction and viscosity introduces a small correction to the sound dispersion. R. W. P.

2377. Physical properties of wood for violin construction. R. B. Abbott and G. H. Purcell. *J. Acoust. Soc. Amer.*, **13,** *pp.* 54–55, *July*, 1941.—The physical properties of nine different woods were studied and employed to determine the factors in the equation of motion of a vibrating bar clamped at one end. Changes in relative humidity affect principally the density of the wood, and Young's modulus is little affected by paints, stains and varnishes. It is suggested that woods might be graded by giving a certain weight to each property and adding up the total score. G. E. A.

2378. Propagation of pressure fluctuations of large amplitude in air columns. L. J. Kastner. *Phil. Mag.*, **32,** *pp.* 206–224, *Sept.*, 1941.—A test of the accuracy of the Helmholtz-Kirchhoff equation for waves in which the average peak amplitude was about 5 in. of Hg above the mean pressure in the pipe. An oscillating piston in a cylinder supplied the pressure pulse to a tube in which the vibrations were built up. The results, using tubes of different dia. and length and different piston speeds, are discussed. The velocity of propagation of pressure waves in air produced in a pipe excited by a piston is independent of frequencies between 20 and 150 c./s. and appears to diminish at a greater rate with decrease of pipe dia. than for cases when the amplitude is very small. The waves are attenuated as they travel along the pipe and when they are reflected at the ends. The open-end and closed-end reflection coefficients are the more important of these and their product does not vary greatly with changes of pipe dia. G. E. A.

2379. Velocity of sound in liquids and chemical constitution. M. R. Rao. *J. Chem. Phys.*, **9,** *pp.* 682–685, *Sept.*, 1941.—Recently obtained data reveal the law, $v^{\frac{1}{3}}M/\rho = R$ where v is the velocity of sound in the liquid, M the mol. wt., ρ the density and R a const. independent of temperature. The result of plotting R against the mol. wt. of members of homologous series leads to the equation $R = aM + \beta$, where a is a general const. and β a characteristic const. for any one homologous series. The difference in R for successive members of homologous series is a const. independent of the series and R is an additive function of the chemical structure. Values of R for H, C, O, Br and Cl are tabulated. Author.

2380. Ultrasonic velocities in solutions. L. Sibaiya and R. L. Narasimhaiya. *J. Mysore Univ. B*, **1,** 15, *pp.* 133–140, 1941.—An investigation is made of the variation of ultrasonic velocity with concentration in solutions of naphthalene in organic liquids. The pattern of a spectrum diffracted by the ultrasonic waves is photographed for a number of optical wavelengths; the displacements of the lines are measured and the variations in adiabatic compressibility determined. These are tabulated for naphthalene in toluene, benzene, chloroform and carbon tetrachloride. The free volume of naphthalene is also calculated. The mean velocity in naphthalene at 25°C. is 1 554 m./s. which is in good agreement with Schaaffs' result [Abstr. 3681 (1937)] whose method of extrapolation is, however, not regarded as entirely justified. G. E. A.

2381. Acoustics of cinema auditoria. C. A. Mason and J. Moir. *J. Instn Elect. Engrs*, **88,** *Part III*, *pp.* 175–186; *Disc.*, 186–190, *Sept.*, 1941.—Details are given of frequency characteristics and reverberation times, and the requirements of good auditorium design are set out. The sound levels picked up by a microphone in an auditorium, and recorded on a high-speed level recorder, are shown by means of oscillograms. Authors.

2382. Technique of industrial methods of making gramophone discs. W. A. Günther. *Bull. Assoc. Suisse Élect.*, **32,** *pp.* 291–296, *July* 4, 1941. *In German.*—Dealing with the technical problems connected with the machines used in registering the sound, the author describes a machine of his own construction. The mathematical principles of construction of recording machines (cutters) are outlined. Different methods for judging the sound qualities of the engraved tracks are given. G. E. A.

2383. Ball-bearing noise and vibration. W. T. Buhl. *J. Acoust. Soc. Amer.*, **13,** *pp.* 51–53, *July*, 1941.—The largest portion of bearing noise originates in the bearing as vibration, with the machine acting as sound radiator. A frequency analysis, first with plain bearings then with ball, shows no important difference between the 2 types. There is a sharp drop in sound radiating efficiency when the size of the radiator is smaller than ½ wavelength. Resonance conditions are seldom eliminated by a smooth running ball bearing. The most frequent causes of excessive bearing vibrations are dirt and ball denting. G. E. A.

✱**2384. General-purpose vibration meter.** H. H. Scott. *J. Acoust. Soc. Amer.*, **13,** *pp.* 46–50, *July*, 1941.—A sound-level meter is used as a basis with a suitable piezo-electric pick-up covering a frequency range of 2 000 c./s. down to 2 c./s. Measurements may be made of displacement, velocity and acceleration, in in. units, the sensitivity being 16 μin. to 30 in. for displacement. 160 μin./sec. to 300 in./sec. for velocity and 0·16 in./sec.^{2} to 3 900 in./sec.^{2} (approx. $10 \times g$)

for acceleration. Readings are shown on an indicating instrument having a semi-log scale. The instrument is portable and self-contained, with facilities for self-checking. E. H. W. B.

2385. Sound absorption, specific heat and period of adjustment of the electron spin in NO. H. O. Kneser. *Ann. Phys., Lpz.*, **39**, 4, *pp.* 261–272, *April*, 1941. *In German.*—The half-value widths and the frequencies of the resonance points of a cylindrical resonator are measured in NO with the aid of the condenser microphone, and from the results the absorption and the velocity of sound are determined, the latter relative to air. Between 300 and 3 000 c./s. the sound absorption is too small to be measured. From the velocity a value is obtained for the sp. ht. which is very close to that calculated from spectroscopic data. From both it follows that at these sound frequencies a delay in establishing thermic equilibrium is not observable, and that especially the distribution of the molecules on the 2 levels of the split ground state occurs in less than 10^{-6} sec. The probability of reversal of the electron spin in a gas-kinetic collision is thus $> 1 : 6\,500$. H. G. S.

2386. Solid CO_2 as an exciter of vibrations. M. D. Waller. *Nature, Lond.*, **148,** *pp.* 185–187, *Aug.* 16, 1941.—The conditions necessary for the production and maintenance of loud tones by means of solid CO_2 are set forth. Tubes, rings and other metal objects, are suitable. The atmosphere must be dry or the object gently warmed. The pressure on the object should be very light and the area of contact small. The range of frequencies most easily excited is about 1 000 to 4 000 and depends on the m.f.p. of the CO_2 molecule but little on the size, shape, mass or material acted on. The similarity to the action of a Trevelyan rocker is pointed out. Series of Chladni figures have been produced, and attention is drawn to several practical applications of the method. G. E. A.

See also Abstract 2310.

ELECTRICITY AND MAGNETISM.

CONDUCTION & DISCHARGE IN GASES.

2387. Chemical syntheses by means of the electric discharge and the improvement of the yields. E. Briner. *Arch. Sci. Phys. Nat.*, **23**, *pp.* 25–56, *Jan.-Feb.*, *and pp.* 79–96, *March–April*, 1941. *In French.*—A discussion is given of the method of synthesis of various compounds by an arc discharge through a mixture of 2 or more component gases. The compounds studied are HNO_3, HCN, C_2H_2, NH_3 and O_3. Three states in the reactions are discussed: (1) the initial processes furnishing the active particles for the synthesis of molecules; (2) the synthesis starting from these active particles, and (3) the properties of the synthesized molecules. Three methods of improving the yields of the reactions are given; (1) the addition to the metallic electrodes of metals having low ionization potentials; (2) the use of gases at low pressures, and (3) the use of h.f. currents. A combination of these methods is shown to produce a much increased yield. It is claimed that by these methods the energy yields in chemical syntheses using electric discharges are far from being as small as is generally supposed. G. O. B.

2388. Relative energy distribution in the continuum of immersed sparks between 9 000 and 5 000 Å. H. Schubert. *Ann. Phys., Lpz.*, **39**, 4, *pp.* 295–307, *April*, 1941. *In German.*—The intensity of spark discharges in water and CCl_4 is investigated. The relative energy distribution is measured photographically and, under water, photo-electrically as well. Within fairly wide error limits there is independence of the material of the electrode and of the nature of the liquid. In contrast, however, to the Unsöld theory [Abstr. 720 (1939)] the energy distribution is not const. in the long-wave region, but resembles that of the black-body radiator. The half-value width of the H_α line has the value 100 Å ± 10%. With this value the part played by the ions is estimated at 5% according to the Holtsmark theory [Abstr. 753 (1919)]. H. G. S.

CONDUCTION IN SOLIDS AND LIQUIDS.

2389. Electronic conduction and the equilibrium of lattice oscillators, J. H. van Vleck. *Rev. Univ. nac. Tucumán A*, **1**, 1–2, *pp.* 81–86, 1940. —An apparent logical difficulty in the usual derivations of the formulae for electrical conductivity in the electron theory of metals is discussed, and it is found that in all practical cases there is no objection to the usual methods. R. P.

2390. On a.c. resistance of porous ceramic materials containing Al_2SiO_5 and partly $MgSiO_3$ (Groups IV B and V of Table DIN 40 685) at temperatures up to 600°. E. F. Richter. *Phys. Z.*, **42**, *pp.* 117–120, *June* 15, 1941. *In German.*—[Abstr. 1563B (1941)].

2391. Deviations from Ohm's law in soda lime glass. R. J. Maurer. *J. Chem. Phys.*, **9**, *pp.* 579–584, *Aug.*, 1941.—The conductivity of soda lime glass has been measured as a function of field strength between 0 and 110°C. The data are compared with a recent theory of electrolytic conductivity of solids. The form of the deviation from Ohm's law is correctly represented by this theory up to field strengths of 7×10^5 V/cm. Reasonable values for the physical constants result from the measurements. AUTHOR.

See also Abstract 2416.

DIELECTRICS AND CAPACITANCE.

2392. Dielectric behaviour of solutions of the protein gliadin. P. P. ENTRIKIN. *J. Amer. Chem. Soc.*, **63**, *pp.* 2127–2131, *Aug.*, 1941.—A combination of the Debye dipole theory and the Perrin study of the hydrodynamics of elongated particles is applied to experimental data involving the protein gliadin in aqueous alcoholic solution. AUTHOR.

2393. H.f. energy losses in solutions containing macromolecules. W. P. CONNER. *J. Chem. Phys.*, **9**, *pp.* 591–599, *Aug.*, 1941.—A quantitative thermal method is described for measuring the loss factor of solutions containing polar molecules. By making use of the Debye dipole theory for both parts of the complex dielectric constant, it is found that normal lignin is fairly homogeneous and has a mol. wt. of approx. 3 900 and a shape factor of 8. The ω-hydroxydecanoic acid polymers show internal rotation of the polar groups in solution, whereas methyl methacrylate linear polymers appear to have less, but still appreciable, internal group motions. AUTHOR.

2394. Dipole moment of sulphanilamide and related compounds. W. D. KUMLER AND I. F. HALVERSTADT. *J. Amer. Chem. Soc.*, **63**, *pp.* 2182–2187, *Aug.*, 1941.

2395. Inductive mechanism of dipole interaction and the estimation of molecular dipole moments. A. E. REMICK. *J. Chem. Phys.*, **9**, *pp.* 653–658, *Aug.*, 1941.—The problem of calculating molecular dipole moments from constant bond moments is impractical since bond moments are greatly altered by their environment. As an alternative method it is proposed that molecules be considered as substitution products of a simple system of reference compounds whose bond moments are altered by the substitution. Equations for calculating these dipole interactions are developed on the assumption that only the inductive mechanism of electron displacement is operative in saturated molecules. The values of the dipole moments of polyhalogeno-paraffins calculated by means of these equations are found to be in rough accord with the facts. The agreement is much improved by empirical alterations of the values for the electronic polarizations of certain electron groups. AUTHOR.

2396. Temperature dependence of the dipole moments of *o*-chlorophenol and the dipole moments of *p*-chlorophenol, *o*-anisidine and the phenylene diamines. R. LINKE. *Z. phys. Chem. B*, **46**, *pp.* 261–269, *Aug.*, 1940. *In German.*—Measurements carried out with a method previously described [Abstr. 834 (1936)] showed the dipole moment of *o*-chlorophenol to depend on temperature. The heat tonality of the transformation was calculated under the assumption of *cis-trans*-isomerism. The other substances have a dipole moment not dependent on temperature. R. N.

2397. Temperature dependence of the dipole moment of ethylene bromide and chloride. R. LINKE. *Z. phys. Chem. B*, **46**, *pp.* 251–260, *Aug.*, 1940. *In German.*—The dipole moments of the *cis*-modifications of ethylene bromide and chloride are calculated under the assumption of a temperature-dependent equilibrium between the *cis*- and the *trans*-form. The transformation heats are stated. The method of measurement was the same as described in a previous paper. [Abstr. 834 (1936)]. R. N.

2398. Investigation of the relaxation time of mixtures of polar and non-polar liquids. H. SPENGLER. *Phys. Z.*, **42**, *pp.* 134–143, *June* 15, 1941. *In German.*—The relaxation time as a function of the concentration is investigated in connection with the two liquids C_6H_5NO and C_6H_5Cl, of which the former has a very large and the latter a relatively small energy of rotation impedance. The relaxation time is determined by h.f. heating, which is measured calorimetrically by the Harms thermometer method. The technique and the instruments used, such as the h.f. transmitter, valve voltmeter, calorimeter, etc., are fully detailed. The values of the heat developed, dielectric constant, refractive index for different voltages and concentrations for both liquids are recorded in tables, and curves show the h.f. heating and the relaxation times as functions of the concentration. In the discussion of the results it is pointed out that whereas Debye's law—relaxation time ∝ viscosity—holds for dilute solutions, where Brownian movement is a major factor in the arrangement of the dipoles, with higher concentration the mutual action between dipoles preponderates and the ratio (relaxation time)/viscosity—the reduced relaxation time—decreases. The reduced relaxation time is discussed as function of concentration. H. G. S.

ELECTROCHEMISTRY.

2399. Base dissociation constant and electrolytic effect in glacial acetic acid. S. KILPI AND M. PURANEN. *Z. phys. Chem. A*, **187**, *pp.* 276–284, *Nov.*, 1940. *In German.*—The thermodynamic dissociation constant of anthranilic acid in glacial acetic acid at 20°C. was determined as $3\cdot5 \times 10^{-7}$. For the determination the electrolyte content was varied, $LiClO_4$ being used as an additional electrolyte. The electrolytic effect was calculated according to Debye-Hückel with an ion diameter of 8·1 Å. R. N.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2400. The dipole character of the meson, and the difficulties of meson theory. D. Iwanenko and A. Sokolow. *Phys. Rev.*, **60**, *pp.* 277–278, *Aug.* 1, 1941.

2401. Influence of radiation damping on the scattering of light and mesons by free particles. I. W. Heitler. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 291–300, *July*, 1941.—A method is developed for calculating the influence of radiation damping on scattering, and it is applied in particular to the scattering of mesons by free protons or neutrons. It is shown that the effect of radiation damping is to reduce the scattering cross-section, in particular at high energies, and to make it decrease, rather than increase, with energy. This removes a discrepancy between the earlier calculations and experimental evidence. R. P.

2402. Quantum theory of radiation damping. A. H. Wilson. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 301–316, *July*, 1941.—A method for calculating radiation damping is developed which is equivalent to that of Heitler [Abstr. 2401 (1941)]. It is applied to the scattering of mesons and to that of light, and is shown in the latter case to have a negligible effect. R. P.

2403. Effects of heat treatment on field emission from metals. J. H. Daniel. *J. Appl. Phys.*, **12**, *pp.* 645–652, *Aug.*, 1941.—The cylindrical electron projector tube affords a convenient means of investigating the effects of heat treatment on field emission from metals. It is found that large, unstable field currents, designated as anomalous field emission, are due to the presence of surface electro-positive impurities. As evidenced by the blackout of the twinkling projector tube patterns, these impurities may be removed from W, Ta, or Mo by temperatures of 2 200°K. or greater, but it was found impossible to remove them from Ni. While the effect of gas adsorption on anomalous field emission is relatively minor, tube pressures even as low as 10^{-7} mm. Hg increase the frequency of breakdown. This phenomenon is probably caused by rearrangement or disruption of impurity layers, or even of the metal itself, due to positive-ion bombardment. Making surfaces microscopically smooth greatly decreases the magnitude of anomalous field emission currents, and therefore the likelihood of breakdown, but cannot take the place of sufficiently severe heat treatment. Calculations were made which make possible the prediction of the tension on the projection tube filament necessary to prevent violent vibration of the filament as h.v. is applied to the tube. Author.

2404. The scattering of electrons from RaE by thin metal foils. J. L. Saunderson and O. S. Duffendack. *Phys. Rev.*, **60**, *pp.* 190–197, *Aug.* 1, 1941.—β-rays from Ra E of energy greater than 0·2 eMV were scattered by thin foils of metal and the distribution of the scattered electrons was measured with a Geiger-Müller counter between the angles 0° and 45°. Two thicknesses each of Al, Cu, Ag and Au foils were used as the scattering material. The thinner set of foils was made of thickness such that each had the same cross-section for single scattering, that is Z^2nt was kept constant, while the second set of foils was made twice as thick. The Wentzel angle was 22° for the first set and 33° for the second. A comparison of the experimental results with the Mott theory in the range above the Wentzel angle was made by integrating over the energy spectrum of the Ra E source used. For the energy and angular ranges investigated it is concluded that such deviations from the Mott formula which exceed experimental error are due to the effects of multiple scattering and the inadequacy of the Wentzel criterion for elements of small Z. The check in absolute magnitude of the scattering is considered satisfactory. Authors.

2405. Silver-magnesium alloy as a secondary electron emitting material. V. K. Zworykin, J. E. Ruedy and E. W. Pike. *J. Appl. Phys.*, **12**, *pp.* 696–698, *Sept.*, 1941.

***2406. Scattering of protons by Mg and Al.** T. R. Wilkins. *Phys. Rev.*, **60**, *pp.* 365–373, *Sept.* 1, 1941.—A new type of nuclear scattering camera utilizing photographic emulsions to determine number and energy of scattered protons at many sharply defined angles is described and compared with earlier experimental arrangements A survey of the effects of various factors in producing straggling of the scattered particles is presented. The angular distributions of elastically and inelastically scattered proton groups are presented, and the former compared with Rutherford scattering. Excited states of Mg nuclei are found to occur at 1·37 eMV, 2·80 eMV and 4·07 eMV. Author.

2407. Multiple scattering of fast electrons. N. L. Oleson, K. T. Chao and H. R. Crane. *Phys. Rev.*, **60**, *pp.* 378–385, *Sept.* 1, 1941.—An extensive cloud-chamber investigation of the scattering of fast neutrons (3–11 eMV) by foils of various elements has been completed. The foils were of such thickness that the resultant average deflection was due chiefly to many deflections through small angles. This fact makes possible a comparison with 2 recent theories of multiple scattering. The results indicate that for elements at either end of the atomic-number scale, the scattering is less than predicted by theory. For elements of intermediate atomic numbers there is good agreement with theory. An attempt was made to detect the effect of crystal size on scattering. The results were negative within the limits of error, and, if such an effect exists, it must be small. Authors.

2408. Velocities of electrons in hydrocarbon bonds. A. L. Hughes and T. Enns. *Phys. Rev.*, **60,** *pp.* 345–350, *Aug.* 15, 1941.—Fast electrons, when scattered inelastically by gas molecules, furnish information on the distribution of component velocities among the electrons. An experimental determination has been made of the distribution of energies among the electrons scattered inelastically from a beam of 8 000 V electrons by acetylene, ethylene, ethane and methane. The results give information on the velocities of the bonding electrons, but not the *K* electrons, of the C atoms. A convenient parameter to summarize the results is the value of the component velocity at ½ max., which is closely analogous to the half width of a spectrum line. Authors.

2409. Proof of the accretion of oxide layers on iron with cathode-ray apparatus. M. Knoll. *Phys. Z.*, **42,** *pp.* 120–122, *June* 15, 1941. *In German.*—The author describes the technique and results of his method for the detection with a cathode-ray tube of the presence of the invisible oxide skin on iron without its removal, which, in general, becomes necessary for the microscopic examination of its properties and cannot always be carried out without changing its structure. Pure, vacuum-annealed iron is placed in a cathode-ray tube after short exposure to air, when it is found that the secondary electron emission is increased. A further, more considerable, increase of secondary emission occurs when the iron is passivated in concentrated HNO_3. When heated for a short time in the vacuum the original secondary emission is re-established, i.e. the passive layer is removed. The different secondary emission of the pure metal and of the thin invisible oxide skin can be applied to the study of the thickness, growth and structure, of corrosion-proof surface layers. Tests of the growths of oxide films on Al and Cu are in progress. H. G. S.

2410. Contribution to the problem of secondary emission of condensed earth alkali metal films. P. Görlich. *Phys. Z.*, **42,** *pp.* 129–133, *June* 15, 1941. *In German.*—After an analysis of the results of earlier investigators the author discusses the results of his own measurements of the secondary electron emission of films deposited by h.f. glow discharges in rare gases, Be on Ag in A, Ca on Ag in A, Kr and He, and Mg on Ag in A. From the results, given in tables and curves, it is shown that such films can be sensitized in this way. As the most probable interpretation a structural alteration of the film is considered. The measurement of δ, the ratio of the secondary to the primary electrons, in dependence on the film thickness indicates that δ passes through a max. with increasing thickness of the film. H. G. S.

2411. Secondary electron emission from Cu single crystals at small primary velocities. G. Benkow. *Phys. Z,.* **42,** *pp.* 144–145, *June* 15, 1941. *In German.*—A preliminary communication of an experiment with Cu crystals to establish whether the secondary electron emission is influenced by the orientation of the emitting surfaces in the crystal lattice. The results indicate that the yields of Cu single crystal and polycrystal surfaces are clearly different, and that every single Cu crystal surface gives a different curve of the yield and primary energy. The highest yields come from the (100) plane. H. G. S.

See also Abstracts 2198, 2299, 2385.

MAGNETISM AND ELECTROMAGNETISM.

2412. Statistics of the 2-dimensional ferromagnet. I–II. H. A. Kramers and G. H. Wannier. *Phys. Rev.*, **60,** *pp.* 252–276, *Aug.* 1, 1941.—In an effort to make statistical methods available for the treatment of co-operational phenomena the Ising model of ferromagnetism is treated by rigorous Boltzmann statistics. A method is developed which yields the partition function as the largest eigenvalue of some finite matrix, as long as the manifold is only 1-dimensionally infinite. The method is carried out fully for the linear chain of spins which has no ferromagnetic properties. Then a sequence of finite matrices is found whose largest eigenvalue approaches the partition function of the 2-dimensional square net as the matrix order increases. It is shown that these matrices possess a symmetry property which permits location of the Curie temperature if it exists and is unique.—The sp. ht. at the Curie point is investigated. The quantity is computed for 6 successive finite matrix problems and the conclusion is drawn that the sp. ht. is infinite at the Curie point. A new closed-form approximation of the partition function λ is developed by using the matrix method in its variational form. The 2 power series for λ at extreme temperatures are used as a test for this and various other approximations, and it is found that the new result is an improvement. Finally, it is pointed out that these closed-form solutions support the conclusion as to the place and nature of the Curie point transition. AUTHORS.

2413. Temperature dependence of magnetic susceptibility of Eu sulphate. H. FRITSCH. *Ann. Phys., Lpz.*, **39**, 1, *pp.* 31–32, *Jan.*, 1941. *In German.*—Relative susceptibility measurements referred to the value at 273°K. are made on a sample of Eu sulphate of 122 mg. using currents of 5 and 10 A at temperatures ranging from 20° to 356°K. The method employed is the one described in an earlier paper [Abstr. 2419 (1941)]. The results inserted in the van Vleck curve for $\sigma = 33$ show good agreements with theoretical expectation. H. G. S.

2414. Absolute saturation magnetization of Ni-Sb and Ni-Ta alloys. G. T. RADO AND A. R. KAUFMANN. *Phys. Rev.*, **60**, *pp.* 336–339, *Aug.* 15, 1941.—The absolute saturation magnetic moment per atom was measured as a function of the atomic composition for Ni-Sb and Ni-Ta solid solutions. Fields up to 40 000 gauss and temperatures down to 77·2°K. were used. The disagreement between the results obtained for the initial slope and the data of Sadron and of Marian is discussed in conjunction with superposed paramagnetism. A complete summary of previous data on ferromagnetic binary alloys shows the present results to be additional exceptions to a surprisingly large range of applicability of the energy-band theory. The anomalous behaviour of the Fe alloys is briefly discussed. AUTHORS.

2415. Magnetic behaviour of magnetite at low temperatures. T. OKAMURA AND S. OGAWA. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 363–369, *May*, 1941. *In German.*—The magnetic behaviour of magnetite, including hysteresis, has been studied at room temperature and at the temperature of liquid nitrogen for different crystal orientations and different field strengths. W. R. A.

2416. Magnetic susceptibility of Ti and Zr. C. F. SQUIRE AND A. R. KAUFMANN. *J. Chem. Phys.*, **9**, *pp.* 673–677, *Sept.*, 1941.—The paramagnetic susceptibilities of Ti and Zr have been found to increase linearly with increasing temperature from 20°K. until a crystal structure change occurs at high temperatures. Electrical conductivity, sp. ht. and thermal expansion studies were made on Zr and the evidence indicates a change in the electron configuration. AUTHORS.

2417. Magnetic and X-ray studies on Ti and Zr with dissolved H. J. FITZWILLIAM, A. KAUFMANN AND C. SQUIRE. *J. Chem. Phys.*, **9**, *pp.* 678–682, *Sept.*, 1941.—Dissolved H in Ti and Zr has the effect of changing the lattice of these metals from hexagonal close-packed to a nearly cubic face-centred lattice. The paramagnetic susceptibility of the system Ti-H and also Zr-H has a value at room temperature different from that of the respective pure metals. The dependence of susceptibility on the H concentration has been investigated for Zr. A small trace of iron impurity which was dissolved in the Zr was found to precipitate out and regain its ferromagnetic property when the Zr was allowed to soak up H. AUTHORS.

2418. Magnetic susceptibility of cadmium amalgams. H. S. V. RAMIAH. *J. Mysore Univ. B*, **1**, 17, *pp.* 155–157, 1941.—The magnetic susceptibility χ of mercury is $- 0{\cdot}169 \times 10^6$. Values for 6 amalgams (0·2–4·6 wt.%Cd) are given and χ diminishes as the percentage of Cd increases, indicating that in solution Cd becomes less diamagnetic as a result of change in the number of free electrons brought about by solution. W. R. A.

2419. Temperature dependence of the susceptibility of Nd salts and the resulting level splitting. H. FRITSCH. *Ann. Phys., Lpz.*, **38**, 7–8, *pp.* 555–564, *Dec.*, 1940. *In German.*—The object of the investigation is to test magnetically how far the Penney and Schlapp theory [Abstr. 5262 (1932)] represents the variation of the susceptibility with temperature, especially whether a parallelism exists between the magnetic and the optical splitting of the levels. For this purpose the temperature dependence of the susceptibility of the Nd salts $Zn_3Nd_2(NO_3)_{12}{\cdot}24H_2O$ and $Nd_2(SO_4)_3{\cdot}8H_2O$ is measured to 20°K. The tests were made with powders, but the apparatus used, which is schematically illustrated, is adapted for experimenting with single crystals. The method adopted is that of the small sample in the inhomogeneous field. The results are in good agreement with the theory as regards the temperature dependence, but the calculated magnetic splitting of the levels does not conform to the optical splitting in the series double nitrate-nitrate-sulphate. The reason for this discrepancy is to be found in the far too simple assumption of a cubic crystal field. H. G. S.

2420. Paramagnetic-dispersion measurements at 77·3°K. C. STARR. *Phys. Rev.*, **60**, *pp.* 241–249, *Aug.* 1, 1941.—The dispersion of the magnetic susceptibility of some paramagnetic compounds of Fe, Mn and Cr, was studied at 77·3°K. over a frequency range of 2 to 10 Mc./s. with magnetic fields up to 60 000 gauss. The results substantiate the theory of Casimir and du Pre, which is based upon the thermal coupling between the magnetic spin system and the lattice vibrations. The magnitude of the crystalline field splitting of the energy levels of the ground state was determined from the experimental results, for an assumed type of crystalline field and ionic arrangement. The splitting of chromic ammonium alum was found to differ from that of chromic potassium alum. The relaxation time for ferric ammonium alum was studied as a function of the magnetic field and was found to fit an empirical formula which is based upon the theoretical conclusions of van Vleck. AUTHOR.

2421. Motion of the electron in a cylindrical symmetrical electromagnetic field. S. MITO. *Mem. Ryoj. Coll. Engng*, **14**, *pp.* 1–14, *Feb.*, 1941.—The general equations of electron motion are applied to the case of a split-anode magnetron, the treatment being limited to 1 value of the specific magnetic field. A. J. M.

2422. Remarks on the volume magnetostriction of Ni. R. SMOLUCHOWSKI. *Phys. Rev.*, **60**, *pp.* 249–251, *Aug.* 1, 1941.—Results of a theory [Abstr. 1082 (1941)] are applied here to the case of Ni, and a correction is made of the data on Fe. The molecular field factor, N, its dependence on volume, the magnetization at abs. zero, I_0, and its dependence on volume, are calculated and discussed. Contrary to the results of magnetocaloric effect, and in accord with the expectations based on the dependence of the exchange integral on interatomic distance, N appears to decrease in Ni with increasing volume (for $j = 1$). To account for the dependence of the magnetization, at abs. zero, on volume it is necessary to assume a dependence of the number of holes in the $3d$ band on the interatomic distance. This dependence can be understood on the basis of the band structure, which can be obtained by extrapolating Krutter's calculations on Cu. Corrected numerical values for Fe are given. AUTHOR.

See also Abstract 2325.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2423. Inactivation of bacteriophages by X-rays. Influence of the medium. S. E. LURIA AND F. N. EXNER. *Proc. Nat. Acad. Sci., Wash.*, **27**, *pp.* 370–375, *Aug.*, 1941.—The authors used the plaque count method of determination, after irradiation of solutions in celluloid tubes with exact X-ray dosage. Curves showing the percentage of bacteriophage after irradiation are exponential for low dosages, whilst, with high dosage, there is only a slight increase. Between 200 and 1 000 kV the inactivation is independent of the quantum (wavelength) of the rays. Sensitivity to rays is a reproducible factor of the particular stain of bacteriophage, and the slope of the inactivation curve is different for different phages. Suspension in water instead of broth, at greater dilution, greatly increases the inactivation for all 4 phages investigated, but the effect is not related to the differences of pH values of the broth and water. Saline solutions behave like water solutions and gelatine solutions like broth solutions, the latter protecting the phages against inactivation. The effect in water is not, as in broth, a function of dosage only, but a time factor is involved, and there are variations for each phage. Inactivation of bacteriophages is a 2-fold effect, there being an indirect effect in water and saline solutions, as though some inactivating agent is produced by the irradiation in the medium, which however has a short life. Protection of the phage appears to depend upon competition between protein and phage in reacting with the inactivating agent. B. J. L.

2424. Analysis of 100 normal electrocardiograms. R. J. VAKIL. *Proc. Indian Acad. Sci. B*, **12**, *pp.* 235–267, *Dec.*, 1940.

***2425. Simple calculator for roentgenographic mensuration.** T. P. TING. *Radiology*, **37**, *pp.* 208–213, *Aug.*, 1941.—The simple relationship between the X-ray object and image size is stated. Ball and Marchbanks devised an instrument which allows the image size to be read when the distance between X-ray source and screen is kept constant. Ball and Holmquest have later devised a calculator in which the source-screen distance can also be variable, but various objections to this calculator are described, such as a 2-step process with double risk of practical error. The author gives the geometrical basis of construction of charts involving the superposition of rectangular and polar charts. It is claimed for the method that it is accurate, simple and inexpensive. B. J. L.

2426. Accuracy of focal-spot determination: some theoretical and practical considerations. L. G. JACOBS. *Radiology*, **37**, *pp.* 214–220, *Aug.*, 1941.—In determining the size of the effective focal spot of an X-ray tube it is commonly believed that the simple geometrical relationship between tube focus, the lead pin-hole used in the method and the film distance and image size, is sufficient to determine the focal size accurately. Hodges proposed a more accurate method using multiple pin-holes. Theoretically only 2 pin-holes are necessary and the author considers an arrangement in respect to the theory of the method, the variations which result from the size of the pin-holes, the inclination of the tube target face to the pin-hole plane, and the effect of inaccuracies of measurement of distances and photographic image size. The actual procedure of measurement is described and, for accuracy, at least 10 measurements should be made under varying conditions of shadow size and distance between shadows, as modified by variation of the pin-hole screen between the target and film. B. J. L.

2427. Evolution of dosimeters in X-ray therapy. O. GLASSER. *Radiology*, **37**, *pp.* 221–227, *Aug.*, 1941.—Concise historical survey of methods which have been used to measure X-ray dosage. Methods described include the method of current, spark gap, distance and time, various chemical methods as that of Holtzknecht, the selenium-cell method, biological methods as effects produced on skin, Ascaris eggs, tumour tissue, etc., attempts to measure the actual energy in calories or ergs, the large and thimble ionization chambers of recent times. Measurements of the quality of radiation by various early qualimeters to the modern spectrometer are briefly referred to. B. J. L.

2428. Effects of heat and ultra-violet light on certain physiological properties of yeast. T. F. Anderson and B. M. Duggar. *Proc. Amer. Phil. Soc.*, **84**, 5, *pp.* 661–688, 1941.

OSCILLATIONS AND WAVES.

2429. Penetration of thin ionospheric layers. A. C. Deb. *Indian J. Phys.*, **14**, *pp.* 451–457, *Dec.*, 1940.—[Abstr. 1457B (1941)].

PHOTO-ELECTRICITY.

2430. Production of a photo-voltage in phosphor cells. F. Goos. *Ann. Phys., Lpz.*, **39**, 4, *pp.* 281–294, *April*, 1941. *In German.*—It is proved that phosphors with transparent metal-sputtered electrodes generate an e.m.f. when exposed to light, similar to the Se (or Cu_2O) photo-element. An attempt is made to separate the photo-electric effect from the partly disturbing secondary phenomena, amongst which a kind of crystal photo-effect is observable. The production of the effect is widely independent of the phosphorescence properties; photo-sensitive centres are, of course, necessary. The e.m.f. is determined for CdSCu, CdSNi and ZnSCu, as well as for the non-luminous but photo-sensitive ZnS crystal and for mixed phosphors, ZnSCdSCu. A rectifier action occurs at the boundary layer. The max. in the spectrum of the photo-voltage with CdSCu is shifted towards the shorter waves, as in the case of the Se cell, in contrast to the secondary current and the dielectric const. The two latter effects conform to the material of the base (CdSCu or Se) and are related to the phosphorescence. The first represents a surface effect in which the nature of the boundary layer plays an important part. The e.m.f. is practically independent of the temperature within the range of at least − 180° to + 50°. The widening of the spectrum is shown to be due to secondary effects of the base; it also occurs with the secondary current and the dielectric const. The spectrum effect changes in the case of a CdSCu cell sputtered with Au instead of Pt. The distribution depends on the method of preparing the phosphor base, as well as on the nature of the photo-sensitive centres, but is independent of the luminescence. H. G. S.

2431. Photo-electric efficiency of ferromagnetic metals at different temperatures in the soft X-ray region. S. R. Rao and K. S. S. Iyer. *Proc. Indian Acad. Sci. A*, **13**, *pp.* 411–438, *May*, 1941.—Soft X-rays from an outgassed Ni target were filtered from ions and electrons and made to fall on one of 4 plates of Fe, Co, Ni, and Cu fitted into a thoroughly degassed lantern. The framework could be rotated magnetically and X-ray incidence made on each target successively. Experiments were made at target temperatures 30° to 950°, and the photo-electron current produced was measured. The photo-electric sensitivity of Fe for soft X-rays was constant up to $\sim 780°$ and decreased by $\sim 10\%$ in the range 780° to 900°, thereafter showing a rise. Parallel investigations on Fe at different temperatures irradiated with ultra-violet light show a change of photo-sensitivity when αFe transforms to βFe, indicating change of photo-electric threshold. Co and Ni have constant photo-electric sensitivity in the range 30° to 950°, indicating that the threshold is unaltered when the hexagonal close-packed changes to face-centred cubic structure at 850°. No change of sensitivity occurs at 358°, the Curie point of Ni. A theoretical derivation is made of the number of photo-electrons emitted from a target for incident soft X-rays corresponding to a given applied potential. N. M. B.

2432. Photo-electric voltage on the metal/semiconductor/metal element. VII. The normal semiconductor photo-electric voltage on metal/CuO/metal. W. Rohde. *Ann. Phys., Lpz.*, **38**, 1, *pp.* 46–58, 1940. *In German.*—The existence of a photo-electric voltage for unidirectional illumination of a piece of CuO at low temperatures is confirmed. This voltage depends linearly on the temperature and decreases for increasing temperature. It shows a break at 190°K. and becomes undetectable above 225°K. It is experimentally found that the thermo-electric and photo-electric voltages are independent of the excitation, i.e. heating or illumination of an electrode. Only the values of the conductivities of the semiconductor at the output electrodes are important. [See Abstr. 1679 (1940)]. M. S. V.

2433. Operation of electrostatic photo-multipliers. R. C. Winans and J. R. Pierce. *Rev. Sci. Instrum.*, **12**, *pp.* 269–277, *May*, 1941.—The photo-multiplier is essentially equivalent to a vacuum photocell plus a high-quality amplifier. The Western Electric D-159 076 has a gain of 70 db and is about 60 db more sensitive than the normal gas-filled photocell. The allowable voltage swing of the output is high enough to drive a power amplifier directly. The frequency response and signal/noise ratio are also much better in the photo-multiplier. While the gas-filled photocell is suitable only for frequencies below 10 kc./s., the photo-multiplier can safely be used at frequencies of several Mc./s.; the response is linear within the operating range; the high sensitivity and output level make it of great use in the spectrometry, colorimetry and photometry of faint sources and tend to considerable simplification of apparatus for many purposes. Care must, however, be taken with regard to changes in sensitivity during operation and with regard to variation of sensitivity with the voltage supply to the tube. A. W.

2434. Effect of wavelength on the relation between the intensity of illumination and current in selenium rectifier photocells. H. H. POOLE AND W. R. G. ATKINS. *Sci. Proc. Roy. Dublin Soc.*, **22**, 40, *pp.* 393–398, *July*, 1941.—The fall in sensitivity (current/illumination) with increasing illumination was greater for wavelengths above 6 600 Å than for other spectral regions. This is not due to increased current leakage in the cell, but may be caused by the occurrence of a threshold for the Se cell in the neighbourhood of 6 600 Å, the number of electrons with sufficient energies to respond to longer wavelengths being so restricted as to increase appreciably the tendency towards saturation. A. J. M.

2435. Photo-electric cells for the visible spectral range. P. GÖRLICH. *J. Opt. Soc. Amer.*, **31**, *pp.* 504–505, *July*, 1941.

***2436. New photo-electric fluorimeter and some applications.** F. KAVANAGH. *Industr. Engng Chem.* (*Analytical Edition*), **13**, *pp.* 108–111, *Feb.* 15, 1941.—Two identical cuvettes, one containing the unknown solution and the other the standard, are irradiated by light from the same ultra-violet lamp. The fluorescent radiation from each falls on a photocell. The two cells are connected in a compensating circuit in order to be independent of fluctuations in the lamp intensity. Examples of the application of the instrument are given. R. P.

THERMIONICS.

2437. The shot effect in a saturated diode. N. R. CAMPBELL AND V. J. FRANCIS. *Phil. Mag.*, **32**, *pp.* 239–244, *Sept.*, 1941.—A mathematical investigation proving by Heaviside analysis that both Campbell's and Schottky's theorems lead to the same result when applied to calculate the shot noise in the external circuit of a saturated diode, so long as that circuit consists of lumped impedances. E. H. W. B.

THERMO-ELECTRICITY.

2438. Electron theory of thermo-electric effects. W. V. HOUSTON. *J. Appl. Phys.*, **12**, *pp.* 519–529, *July*, 1941.